American Machinist

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What are the reasons for replacing obsolete equipment?
How soon should new equipment pay for itself?
What are the steps taken in buying equipment?
Is group or individual motor drive preferable?
Is a repair cost record worth while?
How are obsolete machines disposed of?
What are the faults of machine tools?
How keep informed of developments in equipment?

Conclusive answers to these questions are of extreme importance to the user of shop equipment. The answers have been given in the *American Machinist* in its series of articles, "Getting the Most Out of Your Machine Tool Dollar." But not all of the leaders of the machinery industries think alike on such subjects and the problems are likely to require different answers in different plants. Therefore cross-sections are presented here of the articles as a whole, the statements of company policies being quoted or abstracted, as they apply to the several questions.

In this article, the THIRD *of a series of eight, answers are given to the question*

What Are the Steps Taken in Buying Equipment?

Illinois Central—For the Illinois Central Railroad, the shop superintendent or master mechanic in each shop compiles a list of recommendations for equipment wanted, showing replacement and additional machines. These recommendations are trimmed to suit conditions, corrected or revised. Upon authorization of the budget, the purchasing agent invites proposals. Final selection is made by a machine tool committee.

International Harvester—Everything pertaining to change of equipment of the International Harvester Co. passes through the hands of an equipment engineer, who reports to the general works manager. The superintendents of individual plants send their requests and recommendations to their plant managers, of which there is one for each group of three or four plants. The plant managers pass them on to the general works manager, who has them analyzed by the equipment engineer. OK'd requests are returned to the general works manager, by whom all appropriations for expenditures must be signed.

SKF Industries—In the plants of SKF Industries recommendations originate or clear through the time-study department. They are OK'd by the head of that department, by the production manager, and by the factory manager. The equipment is bought on guaranteed production. The builders of the machines are encouraged to make demonstrations in the SKF shops when the machines are installed.

Delco—As a result of a policy of not cramming equipment down the throats of foremen, all requests for equipment in the Delco (Dayton Engineering Laboratories Co.) plant originate with the foremen. (Information as to the existence of the equipment may have been given to the foreman by the factory manager, research engineer, or some one else.) The requests are investigated by the research department and OK'd by the factory manager. The purchasing department prepares the order, issues it and does the follow-up work.

Westinghouse—In the plants of the Westinghouse Electric and Manufacturing Co. demonstrators recommend that certain machines be bought. Recommendations also originate with machine tool supervisors, who make a physical review every three months and report through their superintendents on equipment needed for greater production, to replace less suitable equipment, or to re-place worn-out equipment. Action is then taken by the director of works equipment.

Hoover—In the plant of the Hoover Co. the foremen make recommendations to the production manager. All details of proposals and quotations are handled by the purchasing department. All salesmen are dealt with through the purchasing department.

Timken—The heads of the factory engineering department, tool equipment department, and metallurgical department of the Timken Roller Bearing Co. make

recommendations for the approval of the purchase of equipment to an operating vice-president. The foremen are consulted by these heads of departments on problems of great detail. Details of ordering and following-up are carried on by the purchasing department. Equipment is bought on trial.

Corona—Negotiations for all purchases for the Corona Typewriter Co. are made by the purchasing department. The purchasing agent advises with the heads of all staff departments interested, usually with the representative of the seller present. The production-equipment engineering department issues the purchase requisition, which passes to the works engineer for his information and action in regard to accessories, installation, and so on, and then to the works manager for approval. The purchase order is then issued by the purchasing department.

National Cash Register—The men who control the acquisition of equipment for the National Cash Register Co. are the superintendent, supervisor, efficiency engineer, foremen, and job foremen. Any one of these men has the privilege of requesting equipment to improve methods or product, reduce cost, and conserve floor space. All requests are studied by the efficiency engineering department. The formal order is made by the efficiency engineering department. The purchasing department follows-up.

Morgan—Anyone in the organization of the Morgan Construction Co. has the privilege of recommending the acquisition of equipment. Every recommendation goes first to the "plant committee," made up of leading foremen and superintendents and presided over by the general manufacturing superintendent. Recommendations of the plant committee go to the "manufacturing committee," made up of the heads of all departments, including purchasing and engineering. The manufacturing committee makes its recommendations to the board of directors, by which the question of making the investment under consideration is settled one way or the other. Most of the sifting is done by the plant committee, responsible for production. Competing machines are gone over point by point. Salesmen of the respective machines are frequently invited to the plant to talk to the plant committee or to the manufacturing committee. Men from the shop sit in at the meetings when it is thought that their experience will be of benefit.

Gleason—At the Gleason Works, ordinary requests for additional and replacement equipment result from checkings of the production program. The production, manufacturing, and methods and tools departments are affected by machine-tool capacity, and have the privilege of requesting equipment. The works manager decides upon the machines to buy. He is helped to reach his conclusions by means of conferences with equipment salesmen, the engineering representatives of the equipment builders, inspection of the machines in operation in other plants, visits to the plants of equipment manufacturers, and consultation with his own shop men and executives. He then makes requisition on the purchasing department to issue the formal order.

It is the policy of the company to have each phase of the examination and consultation taken care of by the man directly interested. The mechanical man looks to the mechanical details and the purchasing agent to the purchasing details. Visiting engineering representatives of manufacturers talk to the interested mechanical man, foreman, superintendent, or works manager. Thus a temporary machine tool committee is formed automatically. Special committees are sometimes appointed to examine one or more machines to report upon their efficiency.

Western Electric—At the Hawthorne Works of the Western Electric Co., equipment specialists determine when new machinery is needed, development engineers work out new methods of manufacture, and standardization engineers have charge of the replacement of obsolete and worn-out production equipment. The duties of the standardization engineers include the development of machine specifications, assistance to and cooperation with machine tool builders, rehabilitation and working out of replacement programs, development of new models of standard types of production equipment. This group takes new projects and developes them for manufacture, including the selection and purchase of equipment.

Chrysler—In the plant of the Chrysler Corporation, orders for new and replacement equipment originate in the master mechanic's division. It is in that division that the sequence of operations for a new production program is made, and requirements for equipment are specified. Proposals for equipment are received while the superintendent of production is considering the operation sheets submitted by the master mechanic's division. With the O.K.'s issued, requisitions for equipment are issued, being forwarded, with proposals, to the purchasing department. Responsibility for obtaining deliveries rests entirely with the master mechanic's division.

Hupp—If the machine foreman and the department foreman of the Hupp Motor Car Corporation agree that replacement is necessary, they take up the matter with the tool supervisor. If he agrees, the three hold a conference with the superintendent, who makes the decision. It is the privilege of the foreman to suggest the make of the machine he wants. The tool supervisor issues a requisition, which passes in turn through the hands of the division superintendent, general superintendent, and works manager. The purchasing agent issues the confirming order to the supplier.

Oil Films and Accuracy

When we begin to talk about accuracy we are apt to be misled by what appear to be real measurements. The thickness of an oil film on a measuring screw may make a difference that can be measured. If we try to squeeze out the oil film by setting the screw up very tight we have introduced stresses that also affect measurement. With the slide of a very massive and very accurate machine set up hard by the screw, and the slide clamped as usual, a lead hammer dropped on the floor beside the machine caused the slide to jump for 0.003 to 0.010 in. as shown by an accurate dial gage. A slight tapping on the machine caused a similar change in the position of the slide.

New Tools Help in Building Automobiles

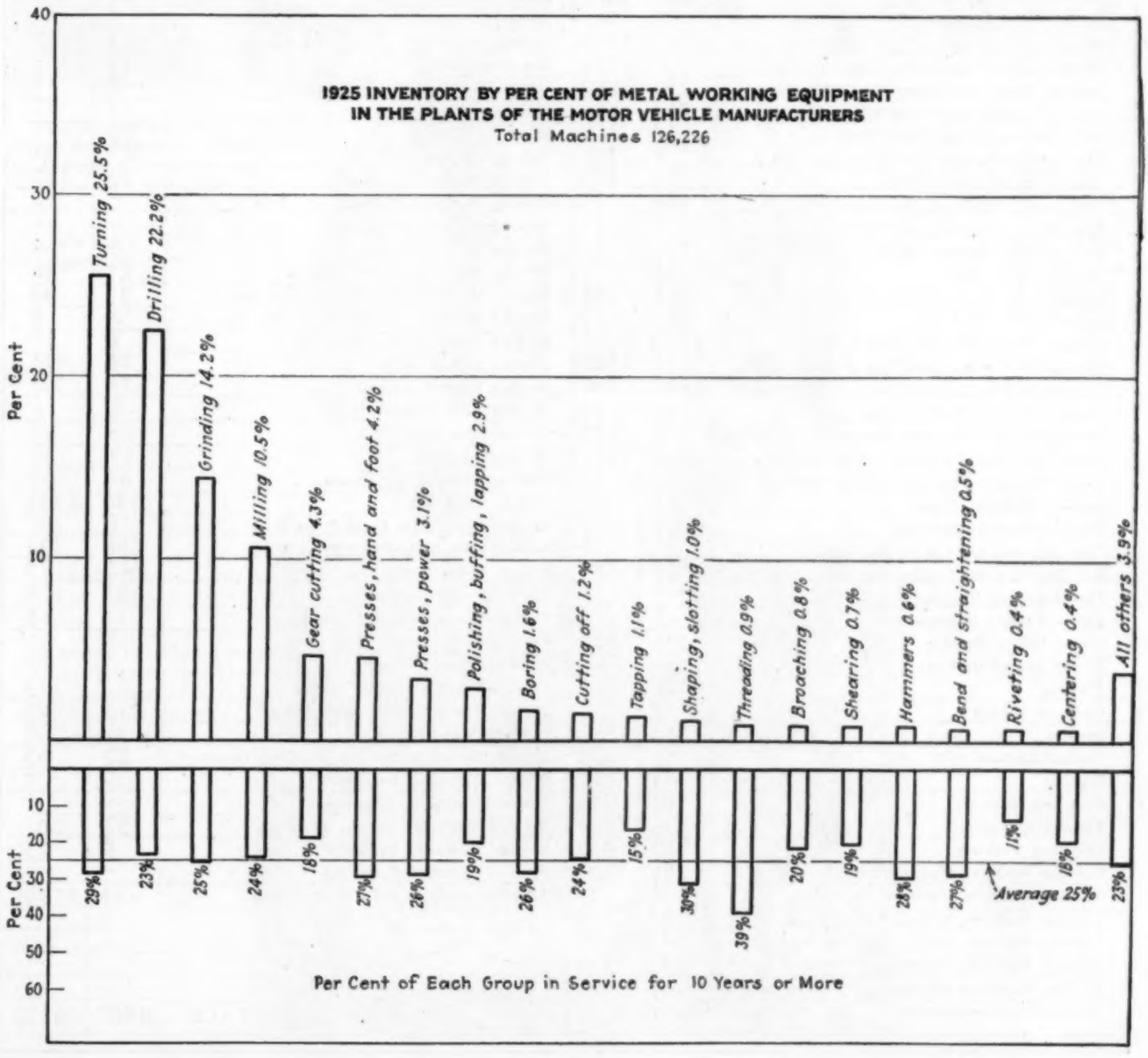
Inventory shows that only twenty-five per cent of equipment is more than ten years old, a vital factor in low cost of automobiles

OF THE total 126,000 metal-working machines that are in service in the plants of the motor vehicle manufacturers, approximately 94,500 have seen less than ten years of service. The machines are distributed through some 300 plants which employ a total of approximately 241,000 workers, according to the U. S. Census of Manufacturers.

These figures form the basis for the chart, shown below, and for the detailed tabulation on the following page. They were obtained from a questionnaire sent by the *American Machinist* to motor vehicle builders.

The chart indicates, at the top, the division of the equipment into operation groups and gives, in terms of per cent, the relative importance of each group. At the bottom of the chart is shown the per cent within each group that has seen ten years or more of service.

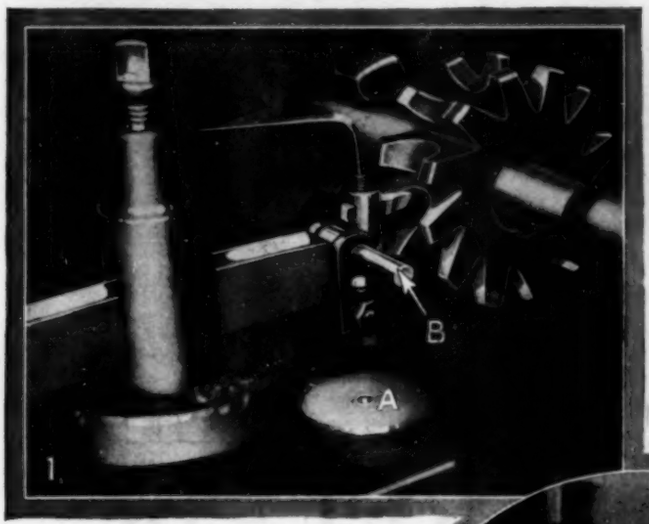
In order to arrive at figures for the entire division, the questionnaire returns were totalled as to machines and as to men in the representative plants reporting. The balance between these two factors was then used to expand the machines to the total of the men employed in the division.



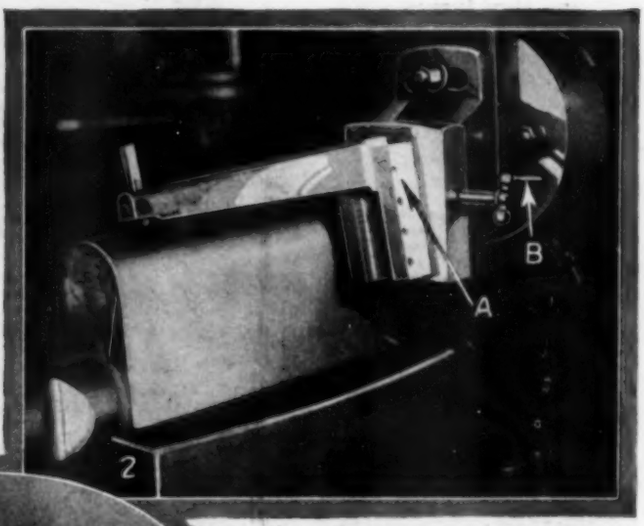
METAL WORKING MACHINES IN THE MOTOR VEHICLE PLANTS

Kind of Machine Tool	A Number Built Before 1915	B Total Number in Plants 1925	Kind of Machine Tool	A Number Built Before 1915	B Total Number in Plants 1925
Engine Lathes	2932	9751	Grinding Machines, Floor, No Feed Attachments	1335	4189
Hand Turret Lathes	1143	3570	Grinding Machines, Bench, No Feed Attachments	44	290
Power Turret Lathes	1178	4210	Grinding Machines, Disk	218	809
Semi-Automatic Lathes	273	1610	Grinding Machines, Belt	27	1098
Hand Screw Machines	371	1419	Grinding Machines, Centerless	27	321
Automatic Screw Machines, Single Spindle	981	2865	Polishing and Buffing Machines, Wheel	632	2974
Automatic Screw Machines, Multiple Spindle	545	2142	Polishing and Buffing Machines, Belt	22	267
Chucking Lathes	529	2700	Polishing and Buffing Machines, Semi-Automatic	-	-
Multiple Spindle Chucking Machines, Rotary Work	60	251	Lapping Machines	44	259
Multiple Spindle Chucking Machines, Rotary Tools	-	-	Honing Machines	11	198
Speed Lathes	708	1662	Cutting-Off Machines, Parting Tool Type	5	30
Bench Lathes	60	259	Cutting-Off Machines, Power Hack Saw Type	202	840
Tool Room Lathes	344	1068	Cutting-Off Machines, Rotary Cold Saw Type	98	366
Wheel Lathes	109	412	Cutting-Off Machines, Band Saw Type	49	212
Axle Lathes	11	46	Cutting-Off Machines, Friction or Hot Saw	11	46
Forge Lathes	16	53	Shears, Knife	114	549
Hand Milling Machines	660	2691	Shears, Rotary	60	274
Bench Milling Machines	5	15	Shears, Slitting	5	107
Plain (Knee and Column Type) Milling Machines	1231	4709	Nibbling Machines	33	183
Universal (Knee and Column Type) Mill. Mach.	600	2135	Hammers, Steam	93	305
Vertical (Knee and Column Type) Mill. Mach.	283	1289	Hammers, Pneumatic (not portable)	5	69
Lincoln Type Manufacturing Milling Machines	223	747	Hammers, Drop	44	137
Semi-Automatic Type Milling Machines	44	886	Hammers, Helve	38	122
Continuous Mill. Mach. Rotary or Drum Type	11	274	Hammers, Spring	27	99
Planer Type Milling Machines	104	450	Riveting Machines, Pneumatic	33	267
Gear Cutting Machines, Rotary or Milling Type	436	2080	Riveting Machines, Hydraulic	-	16
Gear Cutting Machines, Hobbing Type	273	1592	Riveting Machines, Steam	-	-
Gear Cutting Machines, Planing or Shaping Type	284	1760	Riveting Machines, Power	16	168
Vertical Boring Mills	284	1059	Forging Machines, Hot, Bulldozers	27	46
Horizontal Boring Machines	245	998	Forging Machines, Hot, Forging Machines	27	99
Radial Drilling Machines	447	2379	Forging Machines, Cold Headers, Bolt, Nut, etc.	5	8
Upright Drilling Machines, One Spindle	3070	12710	Forging Machines, Cold, Swaging	6	15
Upright Drilling Machines, Two or More Spindles	632	3562	Bending Brakes	98	404
Upright Drilling Machines, Two or More Heads	136	870	Bending Rolls, Horizontal	71	221
Sensitive Drilling Machines, One Spindle	1346	5135	Bending Rolls, Vertical	5	15
Sensitive Drilling Machines, Two or More Spindles	496	2289	Straightening Rolls	16	61
Sensitive Drilling Machines, Two or More Heads	295	1022	Punching Machines	27	84
Two-, Three- and Four-way Drilling Machines	33	198	Combined Punches and Shears	44	137
Tapping Machines, Single	185	1251	Presses, Hand, Arbor	1090	4235
Tapping Machines, Multiple	16	137	Presses, Hand, Light Punch Press Work	76	297
Pipe Threading and Cutting Machines	71	212	Presses, Foot, Light Punch Press Work	256	724
Bolt Threading and Cutting Machines	109	381	Presses, Power, Crank Type	545	2128
Thread Chasing Machines	-	114	Presses, Power, Toggle Type	22	114
Thread Hobbing Machines	5	99	Presses, Power, Double-Acting Type	11	38
Thread Milling Machines	273	381	Presses, Power, Dieing Type	12	61
Thread Rolling Machines	-	-	Presses, Power Automatic	-	15
Planers	136	322	Presses, Power, Trimming Presses	71	244
Open-side Planers	5	15	Presses, Power, Forcing, Arbor, Wheel	278	1090
Shapers	333	1159	Presses, Power, Baling	33	69
Vertical Shapers	16	53	Presses, Hydraulic, Bending, Forming, Drawing	22	99
Slotters	44	114	Presses, Hydraulic, Forging	5	8
Broaching Machines	191	954	Presses, Hydraulic, Flanging	-	-
Keyseating Machines	38	130	Presses, Hydraulic, Forcing, Wheel, etc.	93	305
Centering Machines	82	450	Presses, Hydraulic, Baling	5	23
Grinding Machines, Plain Cylindrical	801	3305	Presses, Hydraulic, Extruding	-	-
Grinding Machines, Universal Cylindrical	540	1457	All other machines and miscellaneous,	654	3540
Grinding Machines, Surface, Reciprocating	191	778			
Grinding Machines, Surface Rotating	147	633			
Grinding Machines, Internal	507	2210			
Grinding Machines, Cylinder	114	763			
Grinding Machines, Cutter	513	2165	TOTALS	31407	126226

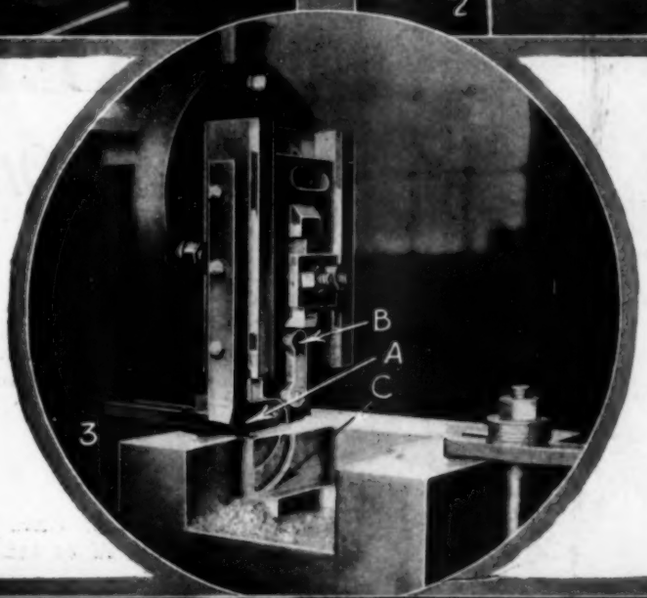
Four Tools from a Railroad Shop Toolroom



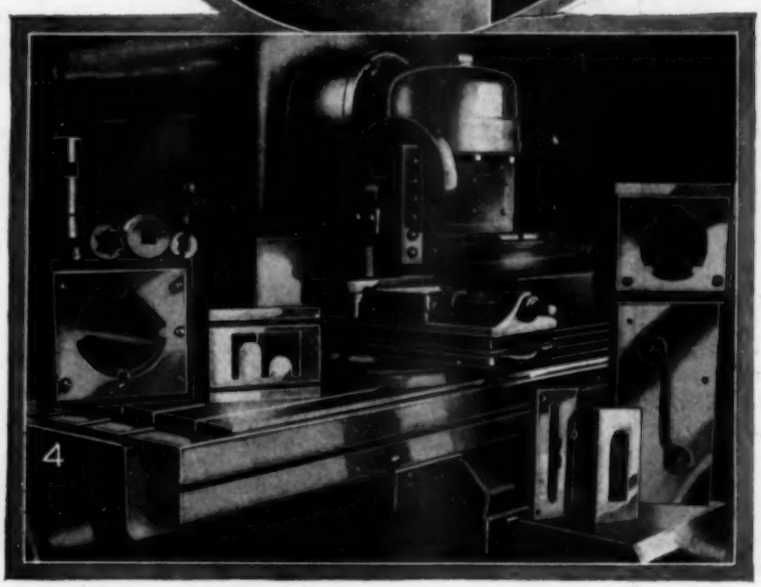
1—Circular attachment for a lathe. The tool is held in a vertical bar upon which a small wormwheel is cut. The worm is on the shaft *B* and is revolved by the knurled knob *A*, to be seen lying on the toolblock.



2—A circular attachment for a shaper. The arm carrying the tool can be set to the desired radius by moving it in the block *A*. Block *A* is revolved by worm gearing, the handle *B* being attached to the worm shaft.



3—Attachment for circular slotting in a milling machine. The tool is pivoted to the stationary bracket *A* and is connected to the ram by the link *B*. The arc cut in the work can be seen at *C*.



4—Slotting attachment for a milling machine. Some of the work done by this device is shown on the table and the knee of the machine. A great saving is effected on the amount of hand work that would otherwise be required.

Photographs by courtesy of the American Railway Foreman's Association.

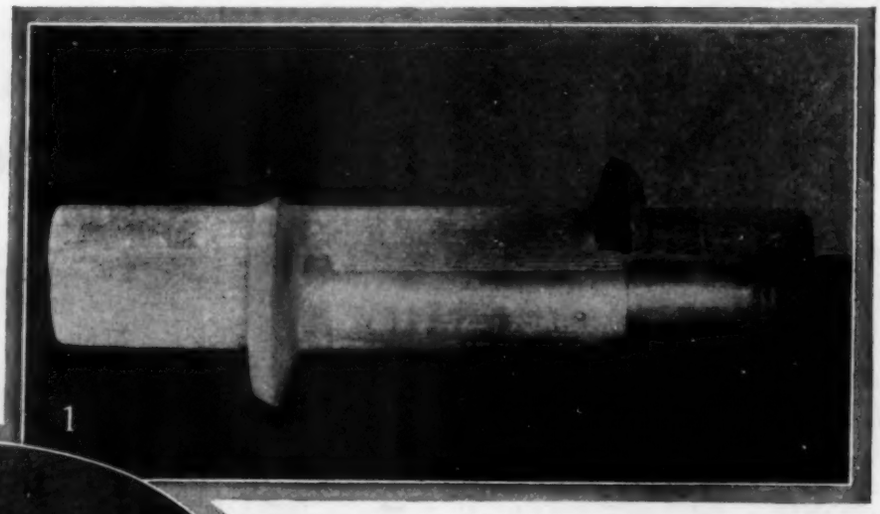
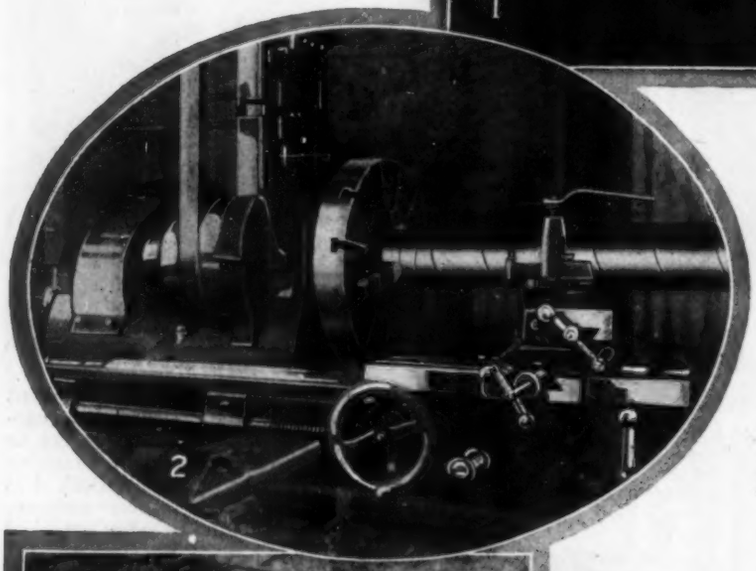


Fig. 1—Swivel sleeves for oil-well drills. Worn journals are built up by welding and then turned

OIL WELL REPAIR

And Other Work



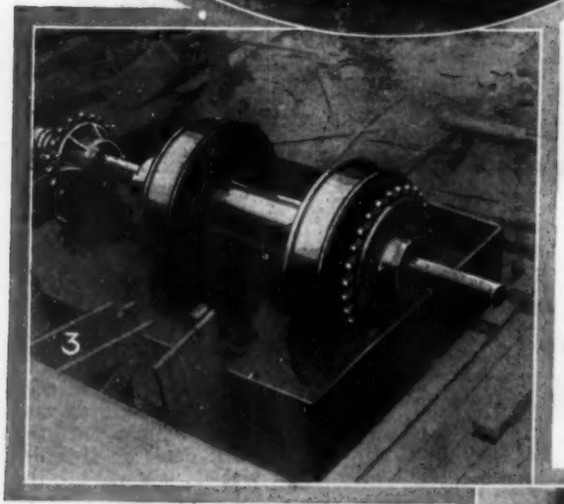


Fig. 2—Chasing threads on a plunger for a long-stroke double pump, of 6-in. lead. When finished, the plunger will have right- and left-hand double threads

Fig. 3—Cleaning tank. Entire pumping engines are submerged and allowed to soak, preparatory to the usual operations involved in overhauling

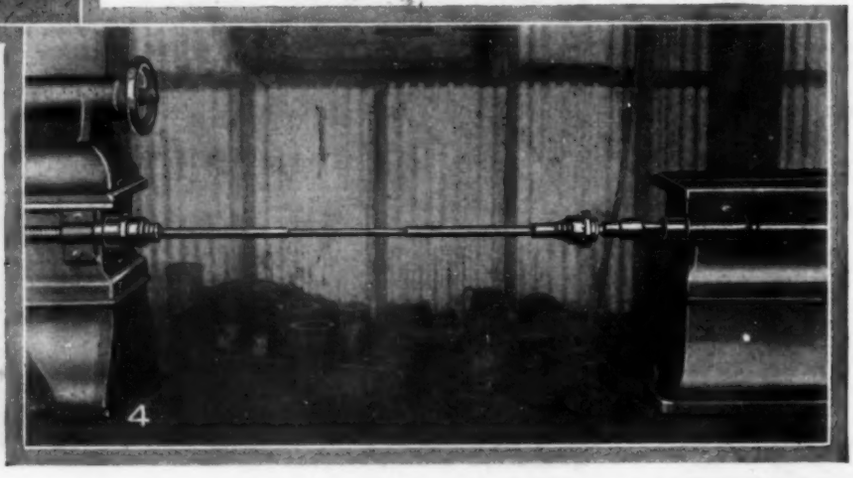
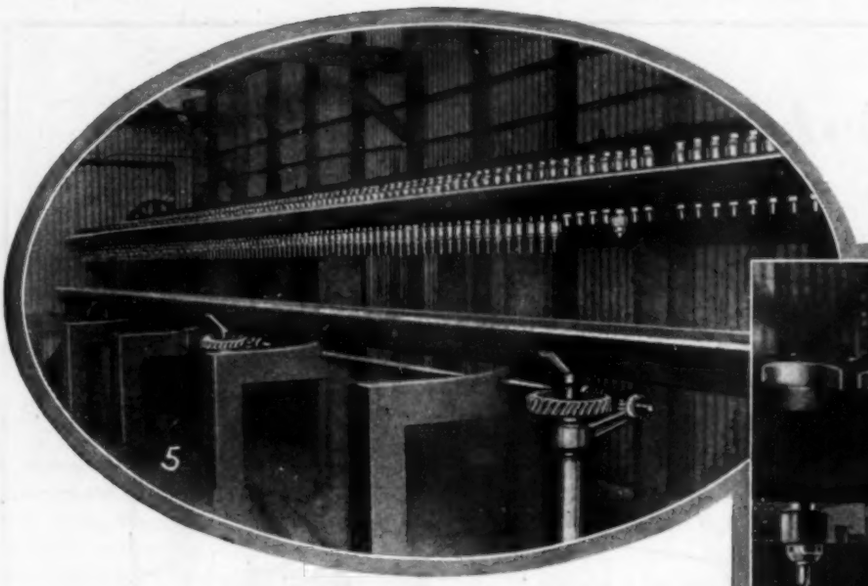
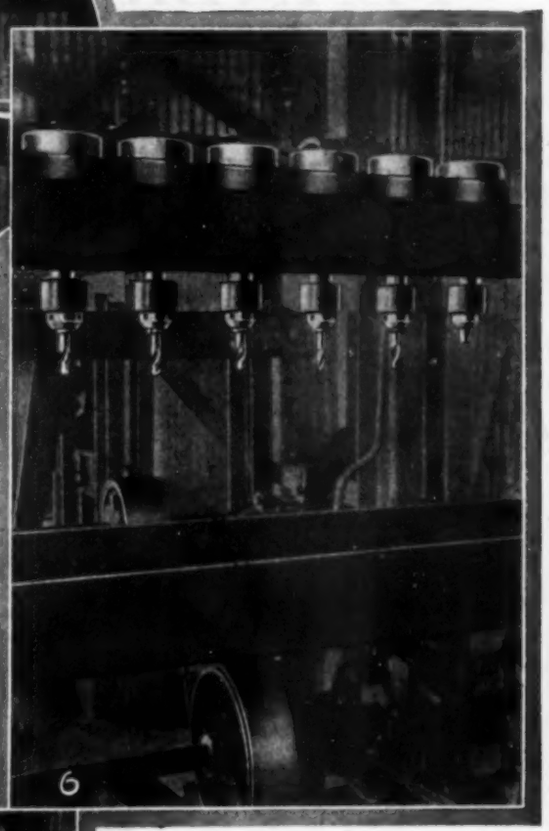


Fig. 4—Two engine lathes connected by telescopic shaft and universal joints, for turning long pieces. To turn the part of a long shaft that would ordinarily be between the lathes, an auxiliary bar is chucked in the first lathe, is supported in a steadyrest, and a second chuck is mounted on the end of the bar. The shaft is chucked in the second chuck and is supported on the steadyrest of the second lathe



Photographs by courtesy of the Watson Perforating Co., Inc., Torrance, Calif.



Figs. 5 and 6—Machine for perforating lengths of pipe as long as 40 ft. There are 137 spindles, 2½ in. center to center. Several rows of holes are spaced around the pipe. The pipe is supported on an angle as in Fig. 5 or on an I-beam is in Fig. 6. Ford-truck worm drives are used to feed the pipe against the drills. Two motors, one at each end of the machine, drive the jack shaft, which is belted to the spindles. Ball radial and thrust bearings are used on the spindles. Cooling water is pumped to the roof of the building and is fed to the high-speed drills by gravity. A chain block, traveling on the I-beam overhead, handles pipes

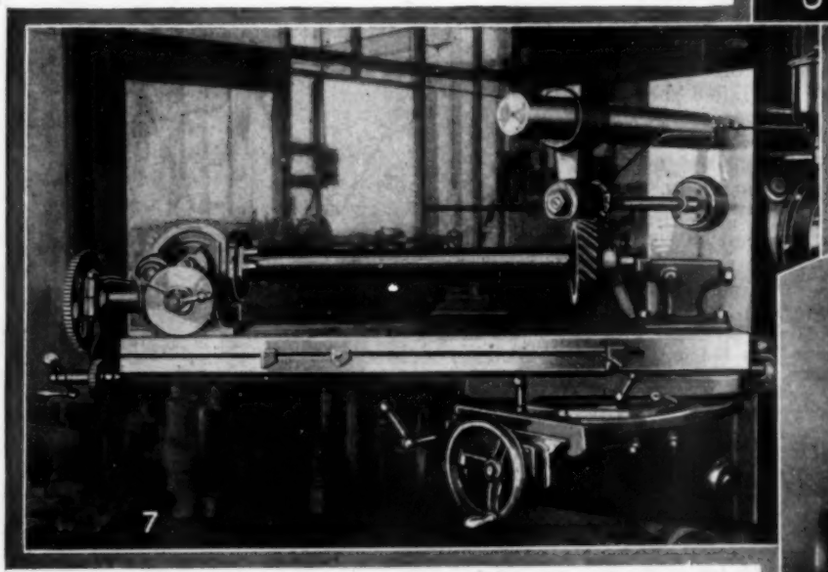
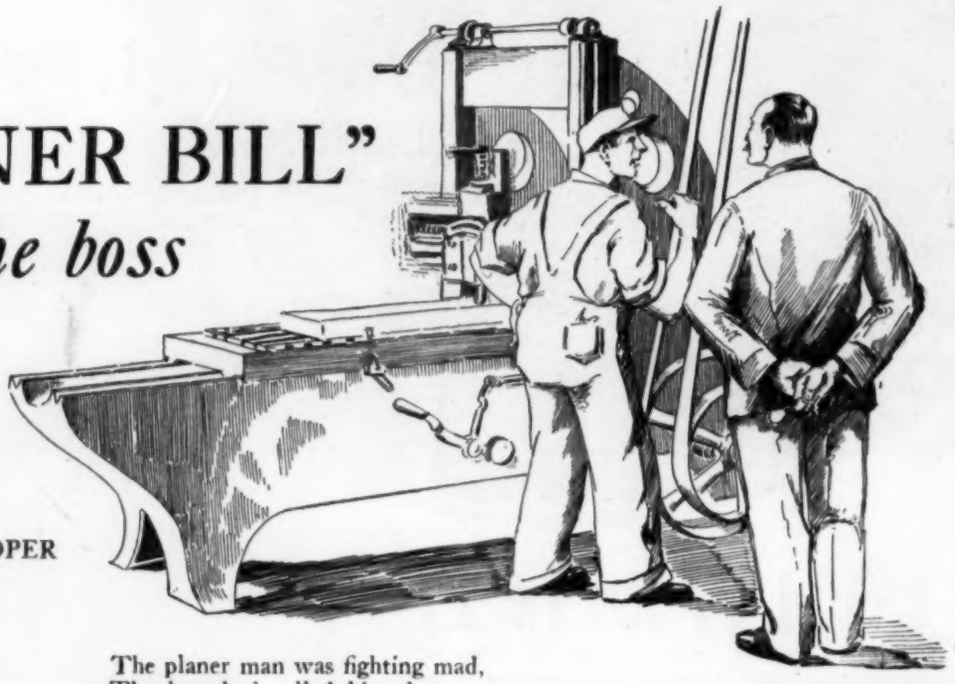


Fig. 7—Milling a spiral gear for a long-stroke pump drive

Fig. 8—Swivel, marked, by welding, with the customer's name and the Watson Perforating Co.'s repair serial number

What "PLANER BILL" *told the boss*



By Loring Roper

The planer man was fighting mad,
The boss had called him down
Because the work dragged on behind
And showed a "bow" or "crown."
"I ran that planer once myself,"
The boss puffed out his chest,
"It was a corking good machine—
Its work was of the best."

"Now that's enough," said Planer Bill,
"Your croaking makes me tired,
I'm going to spill a bunch of facts
No matter if I'm fired.
Of course that planer once was good,
But Noah's Ark was, too,
Yet you'd prefer a later boat
Before you sailed the blue.

"That planer's on the pension list
But still it's in the way;
It's taking space—it's wasting time
And money—day by day.
It isn't planing straight or true,
It just can't stand the gaff—
A new and modern planer would
Just cut your costs in half.

"Because it's old and once was good
You think it's still the same;
To you it's like a monument
Erected to your fame.
But boss, you've got to look alive
Or lose a wad of cash,
Unless you 'can' that planer soon
You'll hear an awful smash.

"If you don't know the new machines
You've fallen sound asleep;
The work they do, the time they save
Would help your custom keep.
They save in floor space, wages too,
They plane both fast and true.
And if you keep that relic there
We'll say good-bye—I'm through."

Gear Teeth in Action

By Earle Buckingham

Associate Professor of Engineering Standards and Measurements
Massachusetts Institute of Technology

Relation of load to wear—Latest test results indicate that for long life the maximum specific stress as given by the Hertz equation should not exceed the elastic limit

IN ADDITION to the problem of the beam strength of gear teeth, that of wear must be solved before the proper proportions of any gears to meet definite requirements of load and speed can be established. Until quite recently, this subject of wear has received but little attention. In the past few years, however, several series of experiments have been made to obtain data on this subject. Much work still remains to be done before we can hope to have a very definite knowledge of the subject.

It has long been realized that on high-speed gears in particular, wear is a much more critical factor than the beam strength of the teeth. This conclusion has led to the use of equations based on a limiting load per inch of face. An equation of this kind, commonly used in the United States, is the following:

$$\frac{W}{f} = KD$$

Where $\frac{W}{f}$ = load per inch of face, lb.

K = constant depending upon load conditions

D = diameter of pinion, in.

A maximum value for $\frac{W}{f}$ is also usually established depending upon the diametral pitch of the gears, the material, and the allowable bearing loads on standard gear cases. The following values of K are often employed for heat-treated steel gears:

$K =$ 62.5 for single-reduction gears, constant service
$K =$ 100.0 for single-reduction gears, constant service, when the full load is only reached occasionally.

Another similar equation that is widely used in England is the following:

$$\frac{W}{f} = K\sqrt{D}$$

In this case, for heat-treated steel gears, the following values of K are often used:

$K =$ 175 for single-reduction gears, constant service
$K =$ 250 for single-reduction gears, constant service, when the full load is only reached occasionally.

No allowance is made in these equations for the effect of pitch-line velocity. They are based on experience with high-speed gears in service. When the gears are made accurately enough to operate quietly at about 5,000 ft. per min. pitch-line velocity, there seems to be but little difference in either their quietness or load carrying ability between that speed and up to 8,000 or 10,000 ft. per minute.

About 1920, E. R. Ross of the Warner Gear Co. started a series of wear tests on hardened steel gears used in automobile transmissions. A report of these tests was presented before the American Gear Manufacturers Association in October, 1921. He stated in this report: "A 50-hp. load was applied to the transmission by the motor dynamometer continuously for 6 hr. This represents an overload for this particular set of gears, being quite beyond anything to which they would be subjected in actual service. Preliminary runs demonstrated, however, that some such overload was necessary if we were going to have any measurable amount of wear in a test of reasonable length of time." He then presented the data of these tests, but drew no general conclusions.

A somewhat similar series of tests were made by Prof. C. W. Ham and J. W. Huckert of the University of Illinois, starting in 1922. The results of these tests were published in Bulletin No. 149 of the Engineering Experiment Station of that university in July, 1925. These tests covered both the efficiency and the wear of spur gears. The test pinions were made of steel and the test gears of cast iron. Here again, in order to accelerate the rate of wear, the tooth loads used were far beyond those that would be used in actual practice. Summing up the results of the tests on durability, the authors stated: "The results of these tests indicate that the factors that have the greatest influence on the durability of gear teeth are lubrication, sliding-action, vibration, and load transmitted. The number of tests in which the speed was varied and the range of speed used were not sufficient to justify the drawing of any conclusions as to the effect of speed."

"In all cases where failure occurred, the cast-iron gear teeth broke down apparently by crushing the material in the region of the pitch line. In no case was there any indication of failure near the outer ends of these teeth other than a slightly pitted condition of the surfaces."

"The unhardened-steel pinion teeth, on the other hand, failed by abrasive wear, which, in general, resulted in a final outline of double curvature."

"Surface pressure is the most important of the factors that affect durability. Apparently for any pair of gears there is a critical surface pressure, governed by the properties of the materials, above which the life of the gears is short and below which the gears will run indefinitely without wear."

In December, 1925, a paper by Professors Marx, Cutter, and Green of Stanford University on "Some Comparative Wear Experiments on Cast-Iron Gear Teeth" was presented before the American Society of

The eleventh article. The twelfth and concluding article of this second series will appear in an early issue.

Mechanical Engineers. In these tests also, heavy overloads were used to obtain accelerated results. The results of these tests followed very closely those of the other similar tests.

A large amount of experimental work still remains to be done before we can hope to have a very definite knowledge of the wear on gear teeth. First, it is of importance to establish definitely whether or not there is for any pair of gears a critical load, beyond which wear is very rapid and inside of which wear is relatively slight, as intimated by Professor Ham. Second, if this critical load exists, it is of great importance to determine its value for any pair. Third, if and when this critical load had been established, it would be of great importance to determine the rate of wear inside of such a critical load. In all previous tests, the rate of wear beyond this critical point has been measured, and the shape into which the tooth profile wore was considered primarily. This last feature is of secondary importance in many ways. The Lewis gear-testing machine now at the Massachusetts Institute of Technology lends itself very readily to tests of this nature, and the Special Research Committee on Gears of the American Society of Mechanical Engineers hopes to have such tests conducted as soon as the opportunity offers itself.

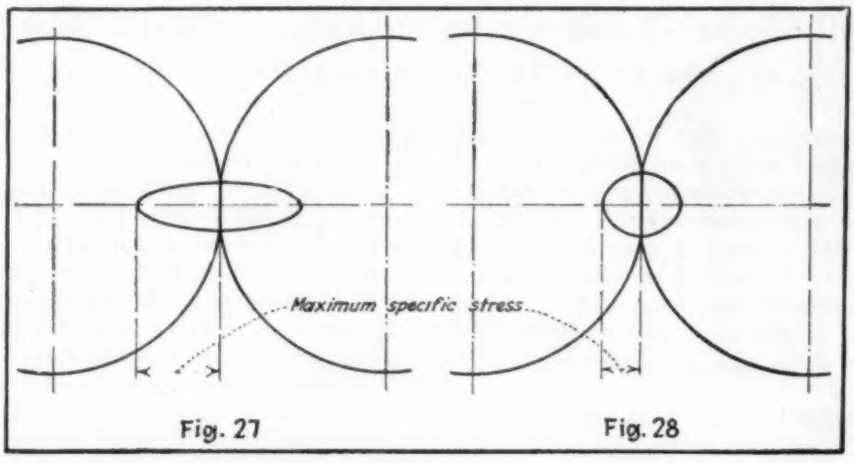


Fig. 27—Stress distribution with two hard metal cylinders in contact
Fig. 28—Stress distribution with two soft metal cylinders in contact

Charles H. Logue, in the *American Machinist's Gear Book*, published in 1910, suggested the use of the radius of curvature of the gear tooth profile as a measure of the stresses on gear teeth that affect the wear. Joseph Jandesek followed this up in articles published in 1920 to 1922, giving numerous formulas, diagrams, and calculations based on the Hertz equation, and using the maximum surface pressure, or compressive stress, as a measure of the wearing qualities.

About 1920, the writer first used the Hertz equation as a measure of gear tooth wear, and in May, 1926, presented before the American Gear Manufacturers Association a paper in which were given constants for various combinations of materials that had proven generally satisfactory during about seven years' use. An abstract of this paper follows.

The contact conditions between spur gear tooth profiles are similar to the contact between two cylinders, except that on gear tooth profiles the radius of curvature is constantly changing. Therefore, if we use the contact and pressure conditions between two cylinders as a measure of the stresses on the surfaces of gear teeth, we must first select some definite part of the gear tooth profile as a basis of comparison.

In many cases wear on gear teeth first becomes apparent at or near the pitch line. Possibly one contributing cause to this effect is the fact that one tooth is usually carrying the entire load when contact is made on this part of the profile, while when contact takes place near the top or bottom of the active profile, two teeth are usually sharing the load. In the absence of definite evidence to the contrary, this supposition gives us reasonable cause to select the radius of curvature of the tooth profile at the pitch line as the one to use as a basis of comparison with the Hertz equation.

When two cylinders with parallel axes are brought into contact with each other, contact takes place along a line that is the tangent element of the two cylinders. When pressure is applied, this line broadens out into a surface as the cylinders are distorted. The greater the pressure, the wider this surface will be. The pressure between the surfaces thus created is not uniformly distributed; the stress is greatest where the distortion is greatest, that is, along the line where contact was first made. These stresses reduce to zero along the line where contact ceases. This condition is illustrated in Fig. 27. The distances along the horizontal axis represent the intensity of the pressures between the surfaces. The area of the parabola would represent the total pressure applied. These pressures, or compressive stresses, are equal and opposite at all mating points of both cylinders.

If a second pair of cylinders of the same size but of softer material, that is, with a lower modulus of elasticity, were in contact under the same pressure as before, the contact surface between them would be broader. As a result, this parabola with a broader base and the same area would have a lesser height. In Fig. 28, this effect is illustrated.

It is not the total pressure or streses that we are interested in, but rather the maximum stress at any point that results from a given load. This stress is known as the "Maximum Specific Stress" and is represented by the height of the parabola shown in Fig. 27 or 28. To determine this maximum specific stress between two cylinders in contact under load we apply the Hertz equation as follows:

$$S^2 = \frac{0.35\,W\left(\frac{1}{R_1}+\frac{1}{R_2}\right)}{L\left(\frac{1}{E_1}+\frac{1}{E_2}\right)}$$

where S = maximum specific compressive stress, lb. per sq.in.

W = load on cylinders, lb.

R_1 = radius of first cylinder, in.

R_2 = radius of second cylinder, in.

L = length of cylinder, in.

E_1 = modulus of elasticity of material in first cylinder, lb. per sq.in.

E_2 = modulus of elasticity of material in second cylinder, lb. per sq.in.

We can transpose this equation and put it in terms of pitch diameter, pressure angle, and ratio of the pair of gears and thus use it as a measure of the compressive stresses set up in gear teeth.

Thus when

R = radius of curvature of tooth profile at pitch line, in.

a = pressure angle

D = pitch diameter of pinion or smaller gear

$$R = \frac{D \sin a}{2}$$

f = length of face of gears, in.

Ws = equivalent static tooth load, lb.

$$K = \text{stress factor} = \frac{S^2 \sin a}{4 \times 0.35}\left(\frac{1}{E_1} + \frac{1}{E_2}\right)$$

$$Q = \text{ratio factor} = \frac{2N}{n + N}$$

n = number of teeth in pinion

N = number of teeth in gear.

This equation now becomes

$$\frac{Ws}{f} = DKQ$$

This equation was used to compare the data from a large number of different gear drives. This comparison was made by solving for K, and thus determining the extent of the maximum specific stress. Needless to say, the results were far from uniform. This condition is to be expected, however, because all gear drives are not loaded to their extreme capacity. One pertinent fact, however, seemed to stand out: *When the stresses thus determined were below the elastic limit of the material, the wear on such gears was not appreciable. When these stresses exceeded the elastic limit, sometimes the gears stood up, but many of them showed signs of rapid wear. It would seem, therefore, as though the elastic limit of the material was a good stopping point to use in determining safe loads for wear.*

It would seem that the rate of wear should be proportional to the pressures, all other factors being equal. As pointed out by Professor Ham, however, there appears to be a critical point, below which the wear is negligible and above which wear is rapid. When the pressures are below this critical load, it is very possible that the rate of wear is a function of the pressure, velocity, etc., and it is hoped that a series of experiments will soon be under way to determine these relationships. The first step towards this end, however, is to establish the critical load beyond which excessive wear takes place.

As a result of the comparisons made on different gear drives, the writer worked up a set of constants for use in establishing the maximum safe load for wear on gears of different materials. In general, they are based on maximum specific stresses of about 75 per cent of the elastic limit of the weaker material. In order

STRENGTH AND WEAR CALCULATION FORM

D.P. _____ C.P. _____ Gear Tooth System _____ Hp. _____ R.p.m. of pinion _____

Tooth Load		(Pinion) $\frac{Ws}{f} = \frac{s}{k} py_1$		Wear		$\frac{L}{f}$ Factor $= \frac{e}{vp} \times \frac{y_1 y_2}{y_1 + y_2}$	
$V = \frac{2\pi R \times r.p.m.}{12}$		$\frac{s}{k}$		$\frac{Ws}{f} = DKQ$		$\frac{e}{vp}$	
$2R = D$		$\frac{s}{k}p$		D		$y_1 y_2$	
$2\pi R$		$\frac{Ws}{f}$	(1)	K		$y_1 + y_2$	
$2\pi R \times r.p.m.$		Gear		$Q = \frac{2N}{N+n}$		$\frac{L}{f}$ Factor	
V		N		2N		Select $\frac{L}{f}$ from table corresponding to V and materials used in gear and pinion	
$W = \frac{33{,}000 \times hp.}{V}$		y_2		N + n			
33,000 x hp.		Material		Q		$\frac{L}{f}$	
W		S		$\frac{Ws}{f}$	(3)	$Ws = W + \sqrt{wL}$	
		k				From table of $\frac{Ws}{f}$, using smallest value of $\frac{Ws}{f}$ at 1, 2, or 3	
Strength Calculations		(Gear) $\frac{Ws}{f} = \frac{s}{k} py_2$					
Pinion		$\frac{s}{k}$				$\frac{L}{f}$	
n		$\frac{s}{k}p$				$\frac{Ws}{f}$	
y_1		$\frac{Ws}{f}$	(2)			$\frac{W}{f}$	(4)
Material						Divide W by value of $\frac{W}{f}$ at 4	
S						(Min. face) f	
k							

V = Pitch-line velocity, ft. per min.
R = Pitch radius of pinion, in.
D = Pitch diameter of pinion, in.
W = Transmitted tooth load, lb.
n = Number of teeth in pinion
N = Number of teeth in gear
y = Lewis form factor
S = Tensile strength of material, lb. per sq. in.
k = Factor of safety, (3 to 6)
Ws = Equivalent static tooth load, lb.
f = Face of gears, in.
p = Circular pitch, in.
K = Wear constant
Q = Ratio factor
e = Tooth error, in.
L = Increment load when equal to W

Fig. 29—Form for use in calculating strength and wear of gear teeth

to simplify the equations, a pressure angle of 14½ deg. was assumed as a constant angle. In Table XII, these constants are tabulated.

The smoothness of surface plays a very important part in minimizing wear. Table XII is based on smooth-cut or ground tooth surfaces with proper lubrication. These values are based on uniform load conditions. Intermittent and shock loads should be studied individually. In all cases, the attempt should be made to determine the tooth loads in terms of an equivalent static load.

One other factor should be mentioned, and that is the relation between the diameter and the width of face of the gear. Sometimes a face of not greater than twice the diameter of the pinion is specified as the maximum face. In general, it would be better to reduce this face to not more than 1½ times the diameter of the pinion. With very wide faces, the torsional deflection of the pinion causes the load to be concentrated toward one end, an effect that causes excessive local wear.

Table XII—Resulting Specific Compressive Stresses with Static Stress Factors

Material	Static K $K=\frac{S^2}{0.35}\left(\frac{1}{E_1}+\frac{1}{E_2}\right)$	Max. Specific Compressive Stress Lb. per in.²	Assumed Elastic Limit in Compression Lb. per in.²
Cast steel and cast steel	25	45,000	60,000
Forged steel and cast steel	30	50,000	80,000 and 60,000
Forged steel and forged steel	40	58,000	80,000
Hardened steel and cast steel*	50	65,000	180,000 and 60,000
Forged steel and semi-steel	60	55,000	80,000 and 80,000
Hardened steel and bronze*	70	62,000	180,000 and 54,000
Hardened steel and semi-steel	80	65,000	180,000 and 80,000
Non-metallic and steel	100	23,000	32,000 and 60,000
Semi-steel and semi-steel	100	58,000	80,000
Heat-treated steel and heat-treated steel	100	92,000	100,000
Hardened steel and heat-treated steel*	150	115,000	180,000 and 100,000
Hardened steel and hardened steel	250	145,000	180,000

* Experience indicates that the action of a smooth hardened tooth with one of softer material burnishes and hardens the surface of the softer material, thus enabling it to carry heavier loads without wear.

As in the case of the beam strength of gear teeth, the first step is to determine the safe static tooth load for wear per inch of face. This can be done with the foregoing formula and constants. The next step is to determine the corresponding unit tooth load under the running conditions. This can be done in the same manner as before.

As definite examples, we will take the same gears as were used to illustrate the determination of beam strength. The first example was a pair of 2-D.P. gears, 20 and 60 teeth, running at a pitch-line velocity of 380 ft. per min. and transmitting 175 hp. These gears are made of hardened steel. Whence we have:

$$D = 10$$

$$Q = \frac{2 \times 60}{20 + 60} = 1.5$$

$$K = 250$$

$$\frac{Ws}{f} = DKQ = 10 \times 250 \times 1.5 = 3{,}750 \text{ lb.}$$

From Table VIII in the tenth article $\frac{L}{f}$ values for steel gears with steel gears, under the column headed with the same factor of 0.00025 as used before and at a speed 400 ft. per min., we find that $\frac{L}{f}$ equals 582 lb. From Table XI of $\frac{Ws}{f}$ values, when $\frac{L}{f}$ equals 600 lb. and $\frac{Ws}{f}$ equals 3,849 lb., we find that $\frac{W}{f}$ equals 2,600 lb. This should be our maximum working load for wear. As the total working load W equals 15,200 lb., the the minimum face f, for wear, will equal 5.84 inches.

The minimum face for beam strength for this pair of gears is 5.66 in. and for wear is 5.84 in. These gears are in successful operation with a face of 6 inches.

The second example is a pair of higher speed reduction gears, transmitting 300 hp. at a pitch-line velocity of 2,200 ft. per min. These are generated, heat-treated steel gears, 3-D.P., of 21 and 84 teeth. Whence we have

$$D = 7.000 \text{ in.}$$

$$Q = \frac{168}{105} = 1.600$$

$$K = 100$$

$$W = 4{,}500 \text{ lb.}$$

$$\frac{Ws}{f} = DKQ = 7.000 \times 100 \times 1.600 = 1{,}120 \text{ lb.}$$

We found before that the value of L/f for this pair of gears was equal to 1,626 lb. From the Table XI (tenth article) of Ws/f, when L/f equals 1,700 lb. and Ws/f equals 1,121 lb., we find that W/f equals 350 lb. The wear value in this example is about one-fourth the beam strength of the tooth, whence the width of face required for wear is the controlling factor. The minimum face for wear, therefore, when W/f equals 350 lb. and W equals 4,500 lb. is equal to 13 in. The width of face required for beam strength, however, is only 2.8 in. These gears are in successful operation with a face of 14 in. As a matter of fact, this pair would be a better design if the pitch were reduced to about one-half the present pitch. This would give a more nearly balanced condition between beam strength and wear.

Whenever many similar calculations are to be made, it is of great assistance to have a prepared form on which to make them. Fig. 29 shows a form that can be used on a sheet or card for gear strength and wear calculations. The use of this form should be self-evident. All formulas required are given, and places are provided to record both the intermediate and final results of the calculations. Table XII should be printed on the reverse side. In use, all known factors are first entered at their proper places. Then the necessary calculations are made in the order as shown on the form. The use of such forms not only facilitates the making of the calculations themselves, but also keeps these calculations in convenient form for filing and future reference.

The use of welding as a manufacturing process is growing steadily. Frames for large machines are now built up of sheet and structural steel. One large company has a rule that welding may be employed for any stationary part of the machine but must not be used on parts that rotate or move rapidly in any manner.

A. S. M. E. Abstracts

These papers were presented December 6 to 9 at the annual meeting of the American Society of Mechanical Engineers, held in New York

Training the Apprentice

By Carl S. Coler
Manager, Educational Department, Westinghouse Electric & Manufacturing Co.

PROBLEMS of personnel are becoming of more importance to the engineer and the industrial executive. The density of population in industrial centers, the increased size and complexity of industrial organization, and the tendency toward specialization in work, are contributing causes. There is no problem of greater importance to the future of industry than that of insuring an adequate supply of skilled artisans and practical leaders. This paper deals particularly with the methods of training which have been found effective in adjusting the old apprenticeship system to modern conditions at the plant of the Westinghouse Electric & Manufacturing Company.

A separate department for apprentice training, charged with the responsibility of training a selected group of employees for the more responsible positions in the organization centralizes the responsibility for the work, and enables a separation of the functions of production and training. It enables the apprentice to be a company employee, rather than a departmental employee. Functionally, the work of apprentice training is divided between supervised shop experience and systematic instruction in the apprentice school.

To insure the best results, training should be started early in the life of the worker and carried on in some manner throughout his employment. Boys of sixteen years of age, who have completed eight grades of grammar school, and who have a desire to learn a trade, are most suitable for the training course. The boys are obtained through co-operation with the public schools, from the families of the more substantial workmen connected with the organization, and through general publicity. Each applicant is given a simple test in arithmetic. This has been found to give a satisfactory indication of the mental ability and general aptitude for the work.

The first six months of training constitute a probation period, during which time the work and attitude of the boys are checked monthly. If satisfactory, an agreement is made between the apprentice, his parents or guardian, and the company. The apprentice agreement outlines the responsibilities of the apprentice and the company to each other during the four-year period of the course. The agreement calls for an apprentice wage scale which is based on the going rate for certain classes of skilled labor in the plant.

The total number of employees at the East Pittsburgh plant varies from 12,000 to 15,000. It requires approximately 300 apprentices, in training at all times, to supply the need for men with training of this kind. This number is determined by the nature of the work, the normal turnover of skilled workmen, the rate of growth of the plant, and the number of boys of the right caliber who apply for training. During slack periods apprentices are not laid off, in order to insure a continuous supply of trained men.

When an apprentice starts his course he is placed in a centralized training department for his first period of instruction. This department manufactures a product suitable for instructional purposes. It is also provided with more and better supervisors than are the sections devoted primarily to production. During dull periods additional work is provided in this section to carry apprentices who cannot be accommodated in other manufacturing departments.

After completing this preliminary training, the apprentice is assigned to work in departments where he secures experience under normal productive conditions. A representative of the training department visits each apprentice in the shop to see that he is interested in his work, that the relationship between the foreman and apprentice is satisfactory, that transfer is made at the proper time, and that his work is justly graded.

Instructors are selected from the shop, drafting rooms, engineering, and commercial departments. Each spends from two to six hours a week in this work. It requires at least 130 instructor-hours each month to carry on the instruction for 100 apprentices. The instructors are compensated for their time in the apprentice school, the rate depending upon whether this work is outside of their regular working hours, and upon their past experience. The instructors attend a noon luncheon each week with the director of the apprentice school. At this meeting problems of policy and with other apprentices.

The school provides a general curriculum for all apprentices. This makes it possible for the boys on each of the trades to become acquainted with other trades and with other apprentices. It also enables the work to be carried on economically.

The subject matter has been developed by the instructors with the idea of creating a background for shop experience. Whenever possible a choice of projects or problems is allowed to take care of the individual

interests of the boys. Also, work is arranged so that each apprentice can progress from one term to another as rapidly as his intelligence and efforts warrant.

The Westinghouse Technical Night School, located near the works, offers a four-year course in engineering fundamentals. Many of the apprentices avail themselves of the opportunity to broaden their technical knowledge by attending classes in this institution three evenings each week. The company assists each apprentice who attends this school in the payment of his tuition. Many apprentices are also similarly assisted in the communities in which they live.

The Possibilities of Chromium Plating

By William Blum
Chemist, U. S. Bureau of Standards

CHROMIUM plating might well be called the sensation of the last few years in the field of protective coatings, a field in which there have been but few radical changes in the last decade. As a number of industrial research laboratories are now engaged in the study of chromium plating, and hundreds of firms are trying it for various purposes, it will no doubt be possible within a few years to make much more definite statements than are now justified.

The outstanding property of chromium, when deposited under appropriate conditions, is its extreme hardness, as measured by its resistance to scratching. A bright chromium deposit, when tested in the Bierbaum apparatus with a sapphire point and a given load, yielded a scratch with a width of about 0.7 micron, which is the narrowest scratch of any metal thus far examined, while the cold-rolled steel on which it was deposited yielded a scratch about 2.2 microns in width.

Another property of chromium is its resistance to tarnish under many conditions of exposure. It will stay bright for long periods not only in an ordinary atmosphere, but also when exposed to a high humidity, to salt air, to elevated temperatures, to molten tin and zinc, to many laboratory fumes, and to concentrated nitric acid. It is, however, readily dissolved by hydrochloric acid, and more slowly by sulphuric. This resistance to tarnish justifies its consideration wherever a bright surface is necessary.

Although chromium itself resists tarnish, it does not necessarily protect an underlying metal against corrosion, if the metal is exposed anywhere, and chromium-plated steel corrodes quickly at points where there are pin holes in the deposit. In this respect chromium is similar to nickel and copper, and unlike zinc and cadmium, which latter will protect small areas of exposed iron. Any superior protective action of chromium plating on steel above that of nickel plating must depend upon producing more nearly impervious deposits of chromium than of nickel. It appears probable that chromium will be applied over nickel plating of good quality, in which case the chromium is chiefly useful for its hardness and tarnish resistance.

With the definite advantages it possesses, it is surprising that chromium plating has been such a recent development. This condition was the result of inability to define and control conditions so that consistent results could be obtained under industrial conditions. Chromium was electro-deposited by Bunsen as early as 1854, and since then numerous papers and patents have appeared. Of the more recent papers, that published by Sargent in 1920, is probably of greatest interest, as most of the methods proposed since that date represent modifications of Sargent's solution.

Sargent recommended a bath of which the major constituent is chromic acid with a concentration of about 33 oz./gal. To this he added a small amount, 0.4 to 0.7 oz./gal. of chromium sulphate ($Cr_2(SO_4)_3$). From such a bath, Sargent and others obtained good chromium deposits, but frequently the results have been erratic. H. E. Haring, from a study at the Bureau of Standards, concluded that in such a bath it was necessary to regulate the acidity. This is accomplished by having present in the bath a colloidal suspension of chromium chromate, which may form automatically, or may be produced by the addition of any basic or reducing substance.

Even more important than the exact composition of such a bath, is the control of operating conditions, especially the temperature and current density. These have an effect in all plating operations, but in chromium plating small variations in these factors may change entirely the character of the deposit, or even prevent deposition entirely. Three principal types of chromium deposit may be produced. At too low a current density or too high a temperature, a "milky" deposit is produced. At the appropriate temperature and current density, at 113 deg. F., and 100 to 200 amp./sq.ft., a bright deposit is produced. At too high a current density, or too low a temperature, the deposit becomes "frosty," gray and "burnt." Of these deposits, the milky form is the softest, and the bright is the hardest, as measured by the scratch test.

It is a simple matter to produce bright, hard deposits of chromium upon articles where a nearly uniform current density may be secured. Upon irregularly shaped articles, and especially those having deep recesses, it is difficult to get a continuous deposit of chromium of uniform properties. Either no metal is deposited in the recess, or else the deposit on the projecting parts is gray and spongy. The latter type of coating is hard to buff to a bright surface. This poor throwing power of the chromium solution is due principally to the fact that the current efficiency decreases rapidly as the current density is lowered.

This limitation appears to be an inherent defect of baths containing chromic acid, and while minor improvements in the throwing power may be effected, there is little reason to believe that it can ever be made to approach that of a nickel plating bath.

Another factor which may affect the introduction of chromium plating on a very large scale, is the large power cost involved. Ordinarily, in electroplating the cost of power is less than one cent per square foot, while with chromium the power cost may be from five to ten times as great.

The cost of the chromium is not prohibitive, and a

coating as thick as 0.001 in. represents only about three cents worth of chromium per square foot. The total cost of chromium plating is certain to be greater than that of nickel, as the investment, the power and the labor cost are higher in chromium plating. But on products for which chromium has advantages, and especially where the general labor cost represents a large part of the entire expense, the greater cost of the chromium plating may be justified.

Among the possible applications of chromium plating, those dependent upon its great hardness are especially promising. One example is its use on plates for printing currency at the Bureau of Engraving and Printing, where the process and conditions developed at the Bureau of Standards are in successful operation.

By the application of about 0.0002 in. of chromium plate to the electrolytic nickel plates, it was found that their useful life may be increased to about four times that of the nickel, or twice that of the hardened steel plates. The impressions are usually sharper, and through the use of a smaller number of plates, greater uniformity and security of the product is secured.

Of more direct interest to engineers, is the application of chromium to gages. In a recent study at the Bureau of Standards the performance of chromium-plated plug gages was compared with that of hardened steel gages. In these comparisons a wear testing machine was employed in which two gages were automatically moved up and down in hardened steel rings, and the wear was measured after a determined number of such gagings. When exposed to sliding friction, with no abrasive present, the chromium-plated gages resisted wear five times as well as any of the steels tested. When, however, abrasives such as fine emery were present, the chromium-plated surface was only 30 to 50 per cent better. This latter result does not mean that the chromium plating is unsuitable for resisting wear by finely divided abrasives such as emery under all conditions, for it was found in lapping wear tests that the chromium resists wear from two to four times as well as the customary gage steels.

In the experiments thus far conducted at the Bureau, a relatively thick chromium deposit, about 0.0008 in., was applied, after which the surface was ground and lapped, leaving a thinner coating of chromium on the gage when it was tested. A simpler and more economical procedure would be to apply a thin chromium layer, 0.0002 in., to a finished, accurately under-dimensioned gage. The latter could then be used directly after plating, and after a length of service during which about half the chromium would have been removed, the remaining chromium could be readily dissolved off, and a new coating applied.

The experience with gages at once suggests the application of chromium to other steel surfaces exposed to wear, that now require special hardening processes. Observations indicate that chromium plating on cams is practical and advantageous. On gears, it may be difficult to produce satisfactory deposits in the depressions, and the wear on the teeth is much more likely to detach the chromium coating. On stamping dies or other surfaces exposed to severe impact, it is probable that a light chromium coating would furnish little protection against the deformation of a soft steel base. If, however, chromium can be made to adhere permanently to a case-hardened die, it would preserve the details. On dies used in molding plastic materials, the application of chromium will probably be advantageous.

The luster and permanence of chromium plating warrant its consideration for reflectors, especially those that are exposed to sulphur fumes such as in locomotive headlights and flood lights. Even though its reflective power is only about 60 per cent, as compared with 90 per cent for silver, the rapid tarnishing of the silver more than offsets this initial difference.

Whenever a bright surface is required that is not exposed to severe corroding conditions, the application of chromium directly to steel will be advantageous, such as on rules and scales for shop use. Where steel articles are to be exposed to the weather, it will be found desirable to apply a coating of chromium over a substantial nickel coating, or still better over a coating composed of a copper and a nickel layer. In the automobile industry great interest is being shown in such applications of chromium plating.

On brass articles, such as plumbing fixtures, where there is little tendency for the base metal to corrode, the chromium may be plated either directly on the brass, or on a nickel-plated surface. In the latter case it is essential that the nickel plating should be very adherent, otherwise it will peel during the chromium plating.

Theory of Milling Cutters

By N. N. Sawin
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TO START the discussion of the action of a milling cutter, imagine a plain cutter with straight radial teeth taking a cut over a piece of work of which the width is less than the length of the cutter. Each point of the cutting edge of the cutter describes a trajectory curve, which is called an abridged cycloid. The thickness of the chip is not interrupted and grows from zero, at the point where the cutter tooth enters the material, to a maximum when the tooth leaves the work. It is clear, then, that the strain on the cutter and on the different parts of the milling machine will vary with the thickness of the chip.

The cutter will resolve into two components running in two main directions, namely, tangential and normal. The tangential component runs in the direction of a tangent to the cutter, and the normal component runs through the axis of the cutter. The tangential component is the pressure of the chip on the front of the tooth, and is equal to the product of the cross-section of the chip and the cutting coefficient.

The fundamental assumption on which the theory rests is that the normal component equals the tangential component. Assuming an ideal cutting edge without land, and an enormous circumferential velocity of the cutter, that is, the cutting velocity equal to infinity, then we may figure the normal pressure equal to zero. In fact, each cutting edge has land, which comes in contact with the metal and causes friction. In case of ab-

sence of land, it would form after a few revolutions. The circumferential cutting speed seldom exceeds 160 ft. per min. The power necessary for cutting is represented by the formula: $\text{Hp.} = \frac{\text{M } 2n}{12 \times 33{,}000}$, where *Hp.* equals the effective power of the cutter in horsepower, *M* equals the torsional moment in in.lb., and *n* the speed of the cutter in rev. per minute.

Let us assume a more complicated case of milling, such as is met in practice, that is, the case of a cutter with spiral teeth. In this case the cutting edge of each tooth will not engage over the entire length at once, but gradually, and will leave the work in the same manner. When cutters with spiral teeth are used one must always consider the axial pressure of the chip. The axial pressure should not pull the cutter out from its seat. A right-hand cutter must have a left-hand spiral and a left-hand cutter must have a right-hand spiral.

One difference between the straight-tooth cutter and spiral cutter is that in the straight-tooth cutter the tooth pressure and the size of the chip are constant at all times, while in a spiral cutter this pressure varies according to engagement, and the thickness of the chip varies with it. The maximum effort in a straight-tooth milling cutter, moreover, occurs at the moment the tooth leaves the work. In a spiral-tooth cutter the effort is continuous, growing from zero to a certain maximum, remaining for a while, and then decreasing again to zero. Accordingly, shocks are avoided, but a periodical variation of effort still exists, only its extent is much smaller than in a straight-tooth milling cutter.

A larger rake angle than 10 deg. is not very useful, neither is a spiral of smaller lead, as with increasing bending moment the efficiency of the cutter will not increase. As far as concerns a mill with straight teeth, milling with such a cutter is accompanied by shocks, and the cutter consumes 2.5 times more energy and produces bending moments 2.8 times greater than a cutter with spiral teeth. For side milling, the depth of cut should not exceed a tenth part of the diameter of the cutter. This fact is explained by theoretical considerations, and is corroborated by many practical experiments.

Laws of Manufacturing Management

By L. P. Alford
Vice President, Ronald Press Co.

THE steady accumulation of facts points toward the establishment of management as a science, and the very complexity of its applications indicates the existence of many rather than a few fundamentals. This possibility is strengthened by the extent of the recent codification of methods and practices.

The principal advantages to be derived from such a body of management regulations, if and when it is developed, are obvious. When once reduced to codified form, these laws may be taught to all students in engineering schools who wish to prepare for executive and managerial responsibilities. They may be consciously applied in every-day managerial and operating activities.

The task of formulating these laws in uniform language now confronts us, realizing that the barriers between the divisions of science are rapidly breaking down, and that management, the science of getting work done, must draw fundamentals from other branches of science wherever they are applicable. To be of the greatest practical value, moreover, laws of this kind need to have established for them experimental factors or statistical quantities for the relationships of the cause and effect that they indicate. Few such factors or quantities have been determined.

This paper attempts to formulate some of these laws of manufacturing management. It presents upward of forty arranged under twenty-five headings. In each case numerous references from experts support the validity and importance of the statement offered. Some of these laws are here abstracted, although the references are omitted.

The law of division of effort or specialization of the individual is that: Assigning to each worker one or a few manual or mental operations which he is particularly adapted to perform greatly improves the quality and increases the quantity of output. As a corollary of this law we can state that: The highest managerial efficiency is obtained by functionalizing the duties of the executives.

The law of standardization is: Fixing the types, sizes, and characteristics of product reduces the cost of its manufacture. Following this is the law of leadership: Wise leadership is more essential to successful operation than extensive organization or perfect equipment.

This latter law has long been recognized in military affairs, having been stated by one of Napoleon's historians as: "A wise direction is of more avail than overwhelming numbers, sound strategy than the most perfect armament." Gantt paraphrased this for industry as: "A wise policy is of more avail than a large plant; good management than perfect equipment."

Another important law is that of exceptions: Managerial efficiency is greatly increased by concentrating managerial attention solely upon those executive matters which are variations from routine.

Curves, charts, and diagrams have had an extensive application in manufacturing operation as a means of bringing exceptions quickly and forcefully to the attention of the management.

The laws of task incentive and individual productivity are stated as follows: The average worker accomplishes most when assigned a definite amount of work to be done in a given time; and, the highest individual productivity is possible only when the worker is given the highest class of work for which his natural abilities fit him.

Other important laws of management are here given: Large-scale production tends to increase operating efficiency and competitive power. The highest efficiency in production is obtained by producing the required quantity of product, of the required quality, at the required time, by the best and cheapest method. The mental labor of production is reduced to a minimum by planning before work is started, what work shall be done, how the work shall be done, where the work shall be done, and when the work shall be done. The highest efficiency in the utilization of materials is obtained by providing the required quantity, of the required quality and condition, at the required time and place.

Lubricating Steel-Mill Machinery

By Charles H. Bromley
Assistant to President, S. F. Bowser & Co.

STRAIGHT-RUN mineral oil does not suffer material change in state or of constituents when cared for properly. The stability of character of the lubricant makes possible the maintenance of its lubricating properties over a long period of time. Because it may be used over and over again, if properly reconditioned, it may be continuously circulated in adequate volume to bearings and gears, and thus vastly improve lubrication. This fact is rapidly promoting the adoption for all classes of heavy machinery of oiltight bearings and gear cases that permit the flow of a stream of clean, cool oil to the working surfaces and the overflow of the used oil.

Steel-mill machinery particularly benefits from this, as bearings and gear cases so provided with a lubricating system make necessary only one oil for both bearings and gears. Consequently, there is freedom from the emulsion troubles so persistent where bearings use oil and the gears use a viscous compound. The compound works its way along the shaft to the bearings, or oil gets mixed with the compound in the gear case. If water is present emulsions are formed.

With the ever-increasing trend toward higher journal speeds and loads, and higher tooth pressures and speeds for gears, the lubricant must function largely as a coolant at the same time that it reduces friction. Therefore, the characteristics of the lubricant are of vital importance. Obviously, the highly viscous compounds and greases are precluded by their lack of fluid properties. Their specific heats are about the same as that of oil when both are derived from petroleum. Ordinary light oils must also be excluded because their viscosities are so low at the working temperatures that they lack "body" to lubricate adequately the hard-worked surfaces, though they might serve well enough if required to act only as a coolant. But the lubricant used must do both. The oil must have opportunity to cool before flowing again to the working surfaces both to restore its viscosity and raise the temperature head between working surfaces and the oil so as to promote rapid heat transfer. It is essential that the oil be a straight mineral oil. If it is compounded and water ultimately gets into it, the two, when subjected to high temperature and violent agitation, will result in a serious emulsion.

Where only journals or journals and gears but lightly loaded, are to be lubricated, it is best to use oils of a slightly lower viscosity than where loads are heavy for both gears and bearings or heavier for the gears than for the bearings. The latter is the usual condition. For heavy loads or where large reduction gears are present, a suitable lubricant is a straight-run mineral oil.

Experience has shown that in most applications of continuously filtered oil special cooling apparatus is not necessary. With an oil volume sufficient for the projected area of journals and gears, the heat lost from the time the oil leaves the bearing and gear housings until it returns is sufficient to restore the viscosity and reduce the oil to a satisfactory temperature. When extra cooling is necessary, it is easily applicable.

Heat for the entire oiling system is beneficial in winter. The heavy oils soon thicken when their temperature gets below 50 deg. F., and flow through the pipe lines is sluggish. The gravity, pressure, and precipitation tanks and the filter should always be provided with heating coils for use until the oil becomes liquid enough to flow readily.

It is interesting to note that enclosed gears such as reduction gears, ordinarily heavily loaded and operating at high speeds, show extremely slow wear when lubricated by a continuous stream of clean, cool, highly viscous oil. The oil is injected in large volume upon the teeth at the place and time they mesh. The tooth speed is so rapid that before the oil can drop away or be squeezed out, the teeth pull out of mesh. The fact that the original toolmarks remain upon the faces of the teeth after months of operation with gears so lubricated, leads to the conclusion that there is little metallic contact. Where the gears simply dip in an oil bath not continuously drained away and resupplied with clean, cool oil, the oil temperature soon becomes so high that the viscosity is too slight to maintain this condition.

Educational Training for Industry

By Matthew Woll
President, International Photo-Engravers Union

CREATIVE expression in work is a strong motive with all men who do work of any kind, whether artists, business men, or the men who run machines. A chance to use intelligence to develop a greater excellence of workmanship is the thing that redeems work from drudgery and makes it worthy of human effort. The workmen realize this in a more compelling way than the business men, managers and directors of their industries, whose work has the intellectual stimulus and variety of executive activity.

Trade education is that which makes skilled craftsmanship possible. The boy who wants to be a carpenter, machinist, or printer, needs a technical knowledge of the trade. This should include the study of mathematics, architecture, physics, English, and such other subjects as are the background of a true understanding and mastery of his craft. It includes also a thorough knowledge of trade processes. Secondly, the apprentice must have trade experience under expert guidance. And thirdly, he must know the economic and business problems of his trade. The boy who is entering less highly skilled work needs less technical education and trade experience, but knowledge of his trade problems is just as essential.

This trade education when carried on through public schools should be under the joint control of employers, the unions, and the public school. Each group has its special contribution to make. The employers have in-

formation about trade problems, access to equipment, and opportunities to give apprentices practical experience; the unions set the standards in craftsmanship, have intimate knowledge of each operation, and can furnish expert supervision and counsel; the schools have the machinery of instruction and educational experience. No one group without the others could give a fully rounded education.

To provide conditions for this creative expression to go on and be the means for increasing industrial efficiency is by no means an impossible task. The average workman develops a technical knowledge of his job and thinks of ways his work might be better done, waste eliminated, and time and energy saved. Because of his intimate contact with job details he can suggest improvements outside the experience of management, and so make a specialized contribution. When he has no channels through which to voice his ideas, they are lost to the industry.

This means must come through co-operation between management and men to increase production efficiency. The welfare of the industry is a real interest with the workers. Their livelihood depends upon it, and the means for increasing their wages must come from its prosperity and efficiency. Therefore, it can well be the basis of co-operation between the two groups, bringing them together in the common work of industrial improvement. But in order that the workers may join with management in wholehearted co-operation, certain conditions are necessary: They must have confidence, and they must feel responsible for their share in the common enterprise; they must know that management will give them the chance to put their ideas into practice when they are worth while; they must know that when profits result from their efforts they will receive their full share. Only under such conditions can the workers' full mental energy be liberated for their work.

The chance for intellectual expression in work is the logical next step in industrial progress. It provides for continued improvement in efficiency without making the worker a mere cog in the industrial machine; it makes full use of the human qualities that are now so often wasted, and at the same time gives the worker a chance to employ creative expression in his work.

The Elements of Metal Cutting

By Orlan W. Boston
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University of Michigan

DURING the last three years an investigation has been conducted as a project of the Department of Engineering Research in the machine tool laboratory of the University of Michigan on the elementary principles involved in the cutting of metals.

It was decided that the experiments should be confined to an investigation of a scientific, rather than of a practical nature. It was felt that the influence of curvature should be eliminated by confining the cuts to straight lines; also that each cut should be of sufficient length to permit the conditions of cutting to become uniform at the instant the reading was taken. In order to secure a straightline cut having a constant cutting speed throughout the stroke, a planer was selected as the machine on which the work would be done, and this was equipped with a special dynamometer for measuring the forces.

All tools used in these tests were of the cut-off or end-cutting type. They were prepared for each problem in groups identical as to geometric form, heat-treatment, and grinding, except for the single variable under consideration. The tools were hardened and drawn in accordance with the specifications received from the manufacturer of the steel. Endurance was not an essential feature of the test, but it was necessary that a tool retain its geometric form with little variation throughout a test. Usually the test was not of sufficient length to cause failure of the tool.

Some of the tools were hardened in a forge fire and others in gas-fired furnaces, the temperatures of which were definitely determined by thermocouples. Our results show that the furnace heat-treated tools give more consistent results than those treated in the forge fire. The materials selected to be cut in the experiments were confined to those which would give a wide range of physical characteristics. They included straight, low, medium and high carbon steel, 3½ per cent nickel steels of high and low carbon, nickel-chromium steel, cast iron, and brass.

The procedure was to grind the tool and cut with it under uniform conditions until the edge became dull, and to observe the length of life of the cutting edge that would make no increase in the reading of the force on the tool. Visual examination of the cutting edge was made during most of these tests, as the change of condition of the edge was so small that microscopic examinations were not considered necessary. It appeared that the original keenness of the ground edge, as is felt by drawing the finger along it, disappeared after the first two or three feet of cutting. The tool then remained in this new condition while cutting several hundred feet. It was found that when the cutting edge again changed, it wore rapidly, and the failure of the tool soon followed.

When cutting cast iron and for a given depth of cut, it was observed that there was no appreciable difference in surface condition after the removal of the chip by tools having various rake angles and degrees of tool sharpness. It was noticed that the beginning of each steel shaving had a smooth, bright surface on the underside for ⅛ to ¼ in., being longer for the greater thicknesses of chip, after which the rough slippage lines appeared and continued to the end of the cut. This seems to confirm the belief that after cutting has started the function of the cutting edge, particularly for the thicker chips, is to support a wedge of the material being cut.

Conclusions may be drawn to the effect that a variation of the clearance angle has no influence on the force to remove the chip. Abrasion on the flank of the tool would probably prove excessive for low clearance angles; yet the less the clearance angle, the more the cutting edge is supported and the more metal there is to carry away the heat generated. It seems desirable, therefore, to select a small clearance angle, but one that will prevent the rubbing of the tool over the work. In commercial practice, the accuracy with which these angles can be ground is one limiting feature, the feed of the tool is another.

Extensive tests were made and charted to determine the influence of side-rake. All of the results for the set of tools having 30-deg. front rake and 0-, 10-, 20-, and 30-deg. side rake, indicate that the value of the side-rake angle has little influence on the unit or total force on the tool in removing a given chip. Other angles of front-rake and side-rake tools indicated that for moderate values the side-rake angle has no influence on the total or unit force on the tool. When the side-rake angle reached 60 deg., a definite increase was noted, and for greater values of side rake the force was markedly increased. Tests on the width and depth of cut showed that the unit force increases rapidly with an increase in width of cut for most metals until a width of 0.24 in. is reached, after which the increase is less.

The curves for the tests show that the unit forces for the very thin chips are high, but are reduced rapidly with an increase in depth of cut. This reduction in unit force becomes more retarded as the depth of cut is increased, so that for depths of cut of 0.030 in., or greater, there appears to be little reduction in unit force for an increase in depth of cut.

Industry's Tax for Handling Materials

By Harold V. Coes
Vice-President and General Manager, Belden Manufacturing Co.

INDUSTRY is spending millions of dollars in payroll for work that could be more efficiently and less expensively done by materials-handling equipment. The total annual payroll of American manufacturing, according to the latest census available, that of 1923, was $14,017,107,000. A survey made for a leading trade paper indicates that the materials-handling labor cost of American industries was approximately 22 per cent of this amount, or $3,084,000,000. Materials-handling equipment now available, together with rearrangement of equipment, relocation of stock rooms, proper coordination of production with materials-handling equipment systems, and adequate plans for procedure would reduce this at least to $2,000,000,000. If we assume the average annual wage for this class of work at $1,000, then the labor released would be 1,084,000 workers.

Because the greater portion of this materials-handling expense is usually buried in the expense payroll, the revelations, after a careful survey of all the factors, are startling. A manager might not know, for instance, that his materials-handling costs per unit of product were 10 cents, and that they might be reduced to 5 cents, or even 2 cents in a concrete case, and that this reduction could be obtained by a capital investment that was within reason. Since the greater portion of the total materials-handling labor is treated as an expense, it gets into the unit cost of production by way of the overhead. Hence, if this overhead is reduced the unit costs are subsequently reduced.

It is amazing how many places there are in an industrial plant where careful studies of materials handling reveal literal gold mines. A manufacturer will spend thousands on new productive equipment that in many instances reduces the prime cost per unit a comparatively small amount, but he should not overlook the greater opportunities of reducing the overhead by similar methods in acquiring materials-handling equipment.

The materials-handling systems installed within the last two years at the plants of the Belden Manufacturing Co. cost $19,611. The labor saving was $19,800, equal to the total installed cost of the equipment, or 1.6 per cent of our payroll. Power to operate the systems costs $400 a year; fixed charges on installed cost amount to $6,950 annually. No labor-burden savings are shown since none of the labor savings enabled the company to make any direct overhead savings. Fixed charges on replaced equipment are nil, as in every case hand labor only was replaced. The yearly profit on the investment resulting from the operation of this equipment is $12,450, or 69.48 per cent. The equipment completely pays for itself out of profits in little more than a year.

Advantages of Decentralization

By Robert E. Newcomb
Superintendent, Deane Works, Worthington Pump and Machinery Corporation

BUSINESS administration as a profession has lacked a time-tested background of tradition, and may profitably appropriate some of the fundamental policies of the professional administrators of armies or states. The business administrator organizes, starts, or carries on a business. The fundamentals of an organization are personnel, training and morale.

The personnel is of first importance. It is the mass of raw material to be welded into an effective organization through training and development of morale. Hence the additions to personnel should be tested with a mental picture of the annual future progress and development of the individual, rejecting those who do not fit into the picture. The subtractions from personnel should be made with great reluctance, and in each case tested with a review of the individual's service, conserving all the skill, experience, and unwritten knowledge that one may, by continued service, pass on, thus insuring a permanent organization.

Training is only second to personnel, as it develops intelligent application of the talents. A trained force inspires the administrator's confidence. The confident administrator deputizes others, subordinating detail, and working with intelligence as well as with energy. This deputizing stimulates the development of both executive and subordinate for greater responsibilities.

Morale is third important factor of organization. The morale of an organization is developed by delegating tasks in order to tax but not overload, the individual. Red tape and deterioration of morale follow in the wake of centralization, sapping loyalty, initiative, and enthusiasm. Concentration of administrative functions bur-

dens the executives with details, stunting their growth and curtailing the development of subordinates. The delegation of responsibilities tests and seasons the lower ranks for new and added responsibilities.

Consolidation and centralization is the order of the day, with local administrative contact lost and executive personality subordinated. Red tape and routine, masquerading as scientific management, become the law and habit, destroying morale and the joy of being boss.

Real scientific management is organized with less thought as to form of organization, and more to vitalize as well as systematize. The progressive consolidation and centralization of administrative functions has in the past developed a general trend toward more economic organization. Malpractices have developed rapidly, so it is well to review and consolidate the gains, and eliminate the evils of this transition period.

Summarized, concentration is desirable for co-ordination only. Beyond that it is strangulation, while discreet decentralization vitalizes an organization. Centralization frequently retards decisive action until the opportune time for action has passed. The initiative in competitive sales and manufacturing effort is lost and destroyed as a result of delayed decisions. Loss of decisive action and initiative is reflected in the lowered morale of organization with the central administrative authority too far removed from local contact throughout the plant.

Fusion-Joining in Aircraft Construction

By Samuel Daniels
Chief, Metals Branch, Engineering Division, Air Service

ARC and gas welding, and to a lesser extent resistance welding, are employed in airplane manufacture. The type of skill needed by the electric welder of aircraft is probably higher than that required for gas welding, because of the danger of damaging the thin sections. On the other hand, it is more simple to weld in corners or angles with the arc weld than with the torch. It is much easier to engage experienced gas welders than electric welders, so that the latter type of personnel may have to be trained on the job. With electric welding, the burden of sources of supply of oxygen and acetylene gas is removed, which is an advantage in large-scale production. The greater mobility of a portable, light-weight oxyacetylene outfit in making repairs in inaccessible places is, however, unquestioned.

The wire for electric welding is of "bright hard" or "bright soft" finish, and that for acetylene welding is a soft annealed wire. When no welding wire is available, strips of the material to be joined may be substituted with good results, especially in gas welding. Metallic electrodes should be uniform in structure and free from hard spots. A line wash is used for coating electrode wires, but fluxes are generally not employed in acetylene welding.

There are several grades of commercial alloy-steel welding wire, but practically all welding done on airplanes has been with the wires described above, which are satisfactory for structural steels not heat-treated.

Investigations by the material section at McCook Field have shown that, in the welding of tubing and sheet, mild-carbon, chrome-molybdenum, and chrome-vanadium steels weld satisfactorily. Chrome-molybdenum, tubing is readily welded with low-carbon-steel welding wire; and chrome-vanadium lugs are easily bonded to chrome-molybdenum tubing, also with low-carbon-steel wire. The use of a chrome-molybdenum welding wire is attended with more difficulty than is the case when low-carbon wire is employed. The former flows less easily and uniformly. In welding chrome molybdenum to chrome-vanadium sheet, this alloy wire produces a finer-grained and more uniform structure than the plain-carbon wire. In alloy-steel welds the use of chrome-molybdenum wire may be justified if the assembly is to be heat-treated to exceed an ultimate strength of 100,000 lb. per sq.in. Chrome-molybdenum steel is welded successfully either by the oxyacetylene or the metallic-arc method. Nickel-steel welding wire has given good results in chrome-molybdenum welds.

Heat treatment of welds refines the grain and alters the structure, thereby improving the mechanical properties. Normalizing and annealing tend to produce a uniform structure in the weld, with resultant improvement in ductility. Unfortunately, properly controlled heat-treatment cannot often be accorded to aircraft. The proper inspection of a welded joint is hardly possible without destruction of the weld, but bad welds may be revealed by testing the joint with gasoline or slushing compound under pressure.

The resistance of a welded joint to bending stresses, applied either statically or in a number of cycles, is less than that of the unwelded material. In tension tests welded butt joints generally fail outside of the weld. In mild steel the breaks were considerably removed from the weld. Under conditions of repetitive stress, however, the failure of butt welds has been shown to take place in or extremely close to the weld. Fractures in the torch welds were directly through the weld, while in the arc welds they were at the immediate edge of the weld.

The welding of aluminum-base materials in aircraft construction is employed to a minor extent only. The weld has only the properties of the cast material, and it has not been found possible to improve the strength of the weld by heat-treatment, as with steel. The use of the strong wrought aluminum alloys of the duralumin type in fuselage, wing structures, and in the landing gear is dependent upon riveting or pinning with sheet stiffeners.

The practice of brazing as applied to aircraft construction is principally in connection with the manufacture of fittings. The Air Service requires dip brazing when practicable, because the operating temperatures can be controlled, and the results are more uniform. Flame brazing is permitted on the basis of conclusive demonstration by actual tests showing that the manufacturer's method is reliable.

Mild-carbon, chrome-vanadium sheet, and chrome-molybdenum tubing can be brazed satisfactorily. Nickel-steel bar and tube, however, have given considerable trouble on account of cracking. Chrome-vanadium steel may be brazed to chrome-molybdenum tubing without difficulty.

The Changed Viewpoint in the Shop

By A. L. DeLeeuw

FORMERLY machine shop practice was considered entirely a matter of skill. In the minds of the workers it was an art. Managers, superintendents, foremen, designers, were all supposed to come from the shop. The few designers who arrived by a different road were looked upon with suspicion, their work was criticised, and every point about which there might be a difference of opinion was pointed out as the result of the foolishness of having things designed by a man who was not practical.

The man who had acquired skill or knowledge, partly by his own experience, partly by reading the scattered pages of past attainments, was called a practical man, and the world was looking toward the practical man for future progress.

It is a good thing for the progress of the world that strictly practical men are extremely scarce, if there is even one. The strictly practical man can only do what he knows. The moment he lets his mind roam into new regions, the moment he thinks out an improvement, the moment he tries to classify his own knowledge, or tries to find reasons for things, that moment he ceases to be a practical man. He becomes a thinker, a theorist. Some men are largely practical and to a very small extent theorists. Others are largely thinkers, and to a very small extent practical men. All progress has come from men who were not wholly practical.

Going back less than thirty years in one of the best-known machine shops of that time the general foreman did not know the speed of the lineshaft nor of any of the countershafts nor did he know any of the speeds at which any of the machines were capable of running. Neither did the foremen nor any of the machine operators. The skilled mechanics knew, or thought they knew, on what step of the cone pulley the belt should be for a certain job and whether the back gear should be in or out. Every new job that came in was a source of experiment as to feeds, speeds, depth of cut.

One of the great changes which has taken place in machine shop practice, and which has come about slowly but progressively, is that now the best men in the machine shop are asking for reasons and are making records. We are still very far from taking the scientific view of this work, but we are headed in the right direction. This change of view is of as much importance as the greatest mechanical innovation or invention which has modified our machine shop practice.

The two elements which we can point out as prominent in the development of this new spirit are the introduction of high-speed steel and of the motor drive. The first one confronted the mechanic with an entirely new set of conditions and made him feel that after all he did not know the things he thought he knew. The second made it absolutely necessary for him to take cognizance of the speeds of his work, the number of revolutions of the machines, and all kinds of positive facts and data which heretofore had been neglected.

When the shop was confronted with an entirely new set of conditions due to the introduction of high-speed steel, men began to interchange experiences. They found that one man could not obtain more than 70 ft. per minute, whereas another could run at 90 on the same material. Gradually the fact was being brought out that there is a relation between feeds, speeds, and depth of cut. Altogether, the shopmen began to realize that there was some kind of law which governed the most economical operation of tools in a machine.

This interchange of experiences, this thinking out as to what should be done under a given set of conditions, is so common with the best men in machine shops today that it may seem strange that attention is called to it here. But this condition has existed for such a short period, and has crept in so gradually, that it is worth while to bring its existence to the foreground.

We are arriving at a condition in which practical experience will be considered as the foundation but not as the end of knowledge, and in which the why and the wherefore will call for more close observation and clean-cut thinking. The time for the theoretical man has arrived; the man who carefully collects facts, classifies them, finds their inter-relation, makes an intelligent guess at the cause, tests out this guess by new experiments, and if he finds nothing which contradicts his hypothesis, say, that he now has found a theory.

The greatest profits in the machine shop will be made by forgetting the profits entirely while the research is going on, and the best results of research will be had by going as near as possible to the root of the matter so that the practical man shall be able to solve the individual problems by his knowledge of fundamentals.

Distribution of Belt Slip

By R. F. Jones

Research Engineer, The Leather Belting Exchange Foundation

TACHOMETERS of various types have been tried on running belts in an effort to study creep, but with indifferent success. Obviously, a small error in the tachometer reading, or a normal variation in the speed of the testing machine, can cause a large error in the results. The scheme finally adopted was to measure the speed of the belt at any point relative to the pulley, rather than the actual speed of the belt or pulley. This was accomplished by applying the principle of the stroboscope. Each pulley had a thin iron disk with equally spaced oblong holes punched around its periphery mounted on the outside edge. The bottom edges of the holes coincided with the edge of the pulley face to allow a clear view of the belt through them.

The portable wheel, which could be placed against the belt at any point, was of such diameter that its holes coincided with those on the disk, as the pulley turned. It was built of steel with a heavy rim, and was mounted on ball bearings. Most of these experiments were made on 24-in. cast-iron pulleys, or a combination of 6-in. and 24-in. cast-iron pulleys. The disk for the 6-in. pulley contained 3 holes, and those for the 24-in. pulleys had 12 holes, while the wheel about 6 in. in diameter, also had 3 holes. Slightly varying diameters were used.

White backgrounds were erected behind each pulley as reflectors to facilitate observation through the holes when they came in line with each other. The belt was first brought up to speed, 2,000 ft. per min. in these tests, at no load, and the wheel was held against the belt at a point about 30 deg. past the point where the belt came on the pulley. Then, by looking at the point of apparent intersection of the holes in the disk and wheel from a position two or three feet away from the disk, an oblong of light could be seen when the holes came into synchronism. If the wheel diameter was just right, the holes would stay exactly in line. Usually the aperture would be moving slightly one way or the other until it disappeared, indicating that the holes were not quite in synchronism. The rate of travel of the aperture under these conditions was the zero error.

It was important in choosing the belts to be used, that they be well balanced, and of uniform thickness to permit smooth running of the wheel. Two endless 4-in. light double leather belts, and one heavy 4-in. single fabric and rubber belt were chosen. The latter was joined with hooks, except for a section about ¾ in. wide at the center, where the hooks were removed to prevent jumping of the wheel as the lace passed under it. They were approximately 30 ft. long, which gave about 12 ft. center distance on the 24-in. cast-iron pulleys. The load was applied in increments depending on the belt, and the slip measured at the six points on each pulley.

The results of the tests were plotted on a series of charts, which showed effectively the action of creep and slip in the belts. The arc over which the belt creeps starts at the last point of contact, and extends in the direction opposite to rotation an amount depending on the load. When the arc of creep coincides with the arc of contact true slip begins. The greatest slip always occurs at the last point of contact.

The amount of load that can be carried by a given belt under given conditions at the merging point of creep and slip varies with the co-efficient of friction. When the co-efficient of friction does not appreciably increase with the rate of slip, the load that can be carried at the merging point is low, and excessive slip occurs when this load is surpassed. When the co-efficient of friction increases with the slip the merging point load will depend upon its value, other factors remaining constant, and much higher loads can be carried without extreme slip. If a small pulley is used with a large one of the same material the merging point will be reached on the small pulley first, and therefore most of the total slip will take place on this pulley.

The Work-Hardening of Metals

By Edward G. Herbert
Edward G. Herbert, Ltd., Manchester, England

IN ATTEMPTING to estimate the resistance which a given metal will offer to a cutting tool it seems obvious that if we except metals such as cast iron and brass, which are broken into fragments rather than cut, the predominating factor must be the hardness of the metal which the tool is actually cutting, since this determines the force that the tool must exert to rupture the metal.

Likewise, in estimating the machinability of a ductile metal by its destructive action on the tool, three principal factors come into play: The force exerted on the tool face tending to cause wear, which depends on the hardness in the path of the tool; the heat generated; and the ratio between the hardness of the tool and the hardness of the metal in contact with it. Thus the resistance to cutting and the blunting of the tool are governed by the hardness induced by the tool. The original hardness is of little account, since this hardness no longer exists where cutting takes place.

The capacity for being work-hardened differs greatly in different metals, and it is convenient to have a means of measuring work-hardening capacity without resorting to a cutting test and the laborious method of sectioning and testing for hardness. The measurement of the hardness induced by cold work is effected by a recently developed method of using the pendulum hardness tester. When the pendulum is placed gently on a specimen the ball makes a mark exactly like a Brinell impression, and when the pendulum is caused to oscillate through a small angle a ball rolls in this impression without slip and the time period of oscillation measures the hardness of the specimen.

The built-up edge is the actual cutting implement when obtuse-angled tools are used on ductile metal, and is formed by the welding together of successive layers of metal derived from the zone of separation. It is much harder than the metal from which it is built up, and assumes a cutting angle appropriate to the cutting conditions under which it is formed. Tools of high-speed steel, when cutting at maximum output, generate temperatures approximating 932 deg. F., even when artificially cooled. This temperature occurs when the chip impinges on the tool. It is the maximum cutting temperature, and the temperature which the tool must be capable of withstanding without softening. A temperature gradient exists in the metal ahead of the tool, and the separation of the chip takes place at a point which is not exactly determined, but is much below the maximum cutting temperature. Steels, non-ferrous alloys, and pure metals undergo remarkable changes at temperatures generally below 572 deg. F. These changes are manifested by fluctuations in their capacity for work-hardening. From the fact that analogous changes occur in metals dissimilar in physical characteristics, it is to be inferred that the changes are connected with that which is common to all of them, namely their crystalline structure.

The changes in work-hardening capacity are not known to affect the structural uses of metals, but have a marked effect on their resistance to severe deformation such as occurs under the action of cutting tools. In particular the decline in work-hardening capacity of steel at the free cutting range of temperatures, about 266 deg. F., is accompanied by a lessened vertical force on the tool, a lessened generation of heat, a different character of chip, a smoother finish on the cut surface, and a great increase in the durability of the tool.

It is not generally practical or desirable to determine the cutting conditions so that cutting takes place in the free cutting range of temperatures, though this may be done in the case of metals which are difficult to cut under any other conditions. There is, however, reason-

to believe that the form of the work-hardening curve can be modified, and that the depression corresponding to the free cutting range can be made deeper and wider by previous heat-treatment of the metal, and perhaps by modifying its composition. A metal so treated offers a slight resistance to cutting over a wide range of cutting temperatures, and can be cut freely under a wide range of cutting conditions, speed, feed, and depth of cut.

Since the limiting factor in the productivity of metal-cutting operations is the inability of the tool to withstand without injury the temperature generated in cutting, an advance in productivity may be sought by providing metals that can be cut at higher speeds without generating excessive temperatures, and by providing tools capable of withstanding higher temperatures without being softened.

Rough Turning Tests on Alloy Steels

By H. J. French and T. G. Digges
Metallurgical Division, Bureau of Standards

THE tests described here were for the purpose of studying the effects of the cut upon the performance of modern high-speed steel tools, as well as to determine whether the fundamental relations developed by Taylor in cutting carbon steels apply also in rough turning alloy steels of high tensile strength and hardness. The tests were made during a period of about three years, included more than a thousand tools, and the cutting of 30 tons of steel forgings.

The original plans for the investigation consisted of a study of tool performance in cutting 3½ per cent nickel, nickel-chromium, chromium-molybdenum, and some carbon-steel forgings having tensile strengths between 80,000 and 150,000 lb. per sq.in. However, as progress was made, suggestions were received from manufacturers to extend the investigation to include tests on steels of higher hardnesses and of other types.

The terms, "machinability" and "machining qualities," have been loosely employed, and to some have meant the finish produced on the work, to others the power required in removing metal, the speed with which machine tools may be operated, or the length of time before tools must be reground. Any or all of these factors may be important under certain conditions, and can be considered to contribute to what has been called machinability. However, the primary object in rough turning is to remove the maximum amount of metal in the minimum time at the least cost. Under such conditions the most important factor is tool life.

Most attention was given to the rough turning of special steels such as are used in automotive construction, for ordnance, railroad equipment, and special machine parts. Lathe tests were also made on some 0.45 per cent carbon-steel forgings for comparisons with the special steels. The tool tests were made after the test pieces had been heat-treated to show equal tensile strengths of 80,000 to 175,000 lb. per sq.in.

A steel that permits a higher cutting speed than another at one tensile strength does not necessarily do so at another tensile strength. Contrary to conclusions reached in previous investigations relating to other types or conditions of cutting, the tests here reported show that steels containing 0.3 per cent carbon and 3½ per cent nickel have better machinability at any selected tensile strength up to 160,000 or 170,000 lb. per sq.in. than steels of similar or higher carbon content containing 1 per cent chromium with or without vanadium or molybdenum. The same applies to a comparison between the 3½ per cent nickel and the higher-carbon nickel-chromium steels. However, above about 170,000 lb. per sq.in. tensile strength the order of superiority is reversed, and the chromium-molybdenum and nickel-chromium steels permit higher cutting speeds.

A noteworthy feature is the very rapid drop in cutting speed with increase in tensile strength of the chromium-vanadium steel. Tensile strengths higher than 140,000 lb. per sq.in. are only obtained at the expense of machinability. For example, under the conditions of the experiments, the speed for the chromium-vanadium steel having a tensile strength of 140,000 lb. per sq.in. was about 37 ft. per min., but dropped to 26 ft. per min. when the tensile strength was raised to 155,000 lb. per sq.in. For a corresponding increase in tensile strength in chromium-molybdenum steel the speeds were respectively 42 and 38 ft. per minute.

These results indicate that the effect of changes in the chemical composition of steel forgings upon their cutting speeds is dependent upon the tensile strength, or hardness, at which comparisons are made. Elements which cause a lowering in the cutting speeds of the annealed steels may improve the cutting speeds when considering higher tensile strengths. The most effective of the special elements in the different steels cut are the combinations of nickel and chromium or chromium and molybdenum, but it should be recognized that carbon increase may also be beneficial. A comparison showed that the low carbon chromium-vanadium steel has the highest cutting speed at low tensile strengths, but the lowest cutting speed at high tensile strengths.

At a tensile strength of about 93,000 lb. per sq.in. stainless iron, containing about 0.1 per cent of carbon and 12½ per cent of chromium, has the same cutting speed as steel containing 0.5 per cent of carbon, 1 per cent of chromium and 0.2 per cent of vanadium.

In general the cutting speed for a fixed tool life increases with decrease in tensile strength, proportional limit, yield point, and breaking strength, and with increase in elongation and reduction of area, but the best general indication of the cutting speed is given by the tensile strength. It is of interest to note that the cutting speed is in no way related to the energy required to break the steel in tension, as was shown from the stress-strain curves made up from the tests.

The three main factors that influence the performance of high-speed steels are: the quality of the tool steel, its heat treatment, and its chemical composition.

The low-tungsten high-vanadium steel has a cutting speed which averages that of the best high-tungsten steel. The addition of about 4 per cent of cobalt to the customary 18 per cent tungsten high-speed steel, combined with a modification in heat treatment, improves performance in roughing lathe tools. It should, however, be recognized that the gains from superior quality of tool steel, cobalt additions, and modifications in heat treatment are greater the harder the steel cut or the heavier the feeds and cuts.

THE · FOREMAN'S · ROUND · TABLE

Why They Decided Not to Use a Jig

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

"I THOUGHT you were going to make a drill jig for that special job, Al, but then I saw Jack drilling the holes from center punch marks. How come?"

"I thought so myself, Ed, when the job came in. Here were a hundred and fifty pieces to make and it looked like a jig job sure enough. But——"

"But what? Still looks to me like you'd slipped a cog that time."

"Maybe so, but I guess not. Jack showed me why. We had a jig all sketched out and asked Jack about a piece price on the job."

"What's that got to do with it?"

"A whole lot. Jack gave us a price on the drilling—but when he saw the jig he went up in the air. 'Holy cats,' says he, 'I aint no Goliath or even a Gene Tunney. That doggone jig is going to weigh forty pounds anyhow, maybe more. Add that to the casting itself and I'll need a hoist or a helper to handle the thing. You better about double that piece price if I've got to wrastle a forty or fifty pound jig into the bargain.' "

"But we want these all alike, Jack," I told him.

"Sure you do, within reason. But have you ever had any trouble with the others I've drilled in smaller lots in days gone by?"

I hadn't, and said so.

"Well, Al, if you'll make a templet of about an eighth-inch plate and give me a center punch that fits the holes pretty close, I'll prick punch those holes and drill 'em so close you'll think it was a jig."

"And he's doing it too, Ed. Saving us money both for the cost of the jig and in the drilling."

"What did Williams say?"

"Oh the super kidded me a bit—but as he was as keen for the jig as I was, it was a joke on him, too. And that isn't all, Ed."

"How come?"

"Williams said, 'Al, you better keep your eye on that boy. He may have the making of a good assistant some of these days. When you find a chap who uses his head like that, try to draw him out. He'll help you into a better job sometimes.' "

"Perhaps, Al—then again, he may help you out of the one you have."

"Don't believe it, Ed. Anyhow, I'm keeping my eye on him."

Was Al too easily persuaded by Jack?

Was he right in letting him have his way?

Would an aluminum fixture have been practicable in this case?

All foremen are urged to discuss these questions. Acceptable letters will be paid for. The discussion is not limited to foremen, of course

Discussion of Earlier Topics

Teamwork in the Shop

ED WAS certainly wrong in refusing to help out Jones when he was asked to do so, especially when he was ahead in his own department. It is fruitless, as Al points out, to pile up work in one department while another is falling behind on some other part that is required to prevent a stoppage on some assembling work. Williams was certainly hitting at Ed when he gave his lecture on co-operation.

For my part I don't see why it should be left to any foreman to say whether work which is urgently needed to even out the flow of finished parts, should be done in his department or not. Williams might lecture on teamwork every day in the week but by the looks of things there isn't going to be much co-operation between Ed and Jones. Williams can't afford to leave teamwork to the whim of foremen of Ed's stamp and he must take steps whereby he can be assured that no stoppage of this sort occurs again.

I should suggest that this most important task of evening out the flow of production be given to the planning or progress department in charge of the production engineer. This is the department which is in the most favorable position for knowing just which department is farthest ahead and can thus take steps to insure the required work being sent through in time.

When a breakdown occurs in any department it should be the foreman's duty to report it to the progress department which should assign the work for the time being, to the department which was farthest ahead. At the same time word could be sent to the foreman of the repair squad who could immediately take steps to repair the breakdown.—JAMES C. HARPER, *Scotland.*

Who Should Boss the Move Men?

OF COURSE, for each foreman to have an extra helper to act as move man seems the easiest and obvious thing to do. I expect many foremen think so. But the more I think of it the less I am inclined to favor this plan. It undoubtedly leads to repeat trips and so long as it leads to split and partial deliveries it will break down the careful planning of the production system.

To have all transportation under the direction of one foreman will more readily provide man power where the job requires more than one man and will reduce the total number of move men so employed. It will also reduce the amount of equipment required.

It is to the advantage of the foreman to be relieved of this detail so that he can carry out the more important duties and tasks of his position. I can't see how he would loose dignity or prestige as Ed seems to fear. —LOUIS C. GAMBONE.

Just What Is Discipline?

THE old man's interpretation of discipline probably meant that men in the shop should feel at ease and at liberty to move around within the shop rules, and not feel like a soldier standing at attention throughout the entire day and unable to relax.

I believe that if two men are working side by side they should not carry on an all-day conversation for it distracts their minds from their work. If a man wants to speak to his neighbor, he should stop his work entirely and get his visit over with so that he can go back to concentrated work. This should not happen too often, however. Before a man leaves his department to visit another department, he should obtain the consent of the foreman.

Rules regarding no smoking are necessary and, in most cases, reasonable. Smoking should not be permitted at the evening closing hour because there will be no one around in case of fire. Smoking while working distracts the mind from the work too much.—JOSEPH E. ABBAZIA, *Mech. Instructor.*

Who Should Boss the Move Men?

THE overlapping that goes on where each foreman has a move man under him is wasteful. One often sees three trucks in department 27, where one truck would have been sufficient and would have been used under the unified control system.

The dignity of the foreman should not suffer under the latter system because the dignity or true worth of a man is known by the manner in which he applies his energy. He should spur himself on to work in conjunction with the trucking boss. His best efforts should be used for co-operation with others so as to advance the efficiency of his organization.

Al is right in saying that a separate transport crew will move the work faster and will reduce the number of trucks and the equipment required to handle the work. By the co-operation of each departmental foreman the boss move man will be enabled to fully load each truck instead of his being obliged to frequently transport small loads.—C. L. HENRY, *Foreman, England.*

THE · NEXT · TOPIC

Should Foremen Accept Presents from Their Men?

QUESTIONS

Do presents and business mix?

When may presents be accepted and when not?

Is the taking of collections for presents for promoted workers likely to make the rank and file happy with the spirit of giving?

Ideas from Practical Men

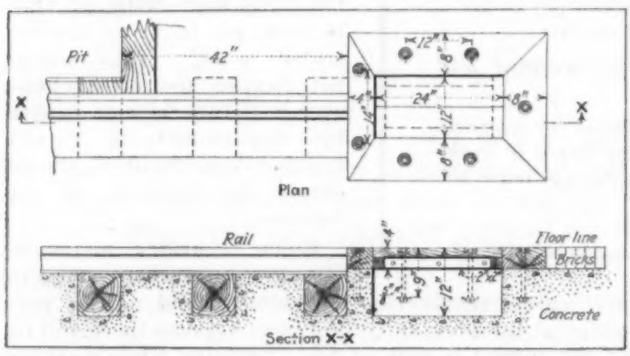
The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from five dollars upward, according to their merit

Saving the Roundhouse Wall

BY J. MADDEN

An arrangement of the roundhouse floor, to prevent locomotives from being driven through the roundhouse wall, is shown in the accompanying illustration. The design is that of the Denver & Rio Grande Western R.R., and is in use at Salt Lake City.

At a point 42 in. beyond the end of the working pit, and just beyond the end of the rail, there is located a second pit, 12 in. by 24 in., 12 in. deep. It is floored over with 2-in. planks supported on 2 x 2-in. cleats that are



Safety pit to prevent locomotive from being driven through roundhouse wall

nailed to heavy timbers resting on the top of the concrete pit-walls. The fastenings are designed to support the weight of a man with a loaded truck, but not to support such part of the weight of a locomotive or tender as would come upon the floor in case of overrun. As shown in the illustration, the safety floor is level with the top of the rail.

Insuring Parallel Planed Surfaces

BY DONALD A. HAMPSON

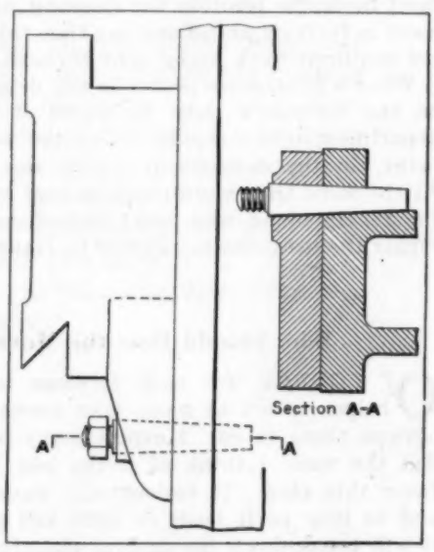
The experience of a machine shop that adopted simple means to insure the parallelism of cuts with the planer table, is a good example of the growing practice to have all possible machine parts set so that they cannot be tampered with or accidentally changed by the stresses of cutting.

In this particular case, on account of gear centers and the fitting of slides, it was not unusual for the requirements to call for an accuracy of 0.002 in. over an area of 30 sq.ft. or even more. The greatest difficulty lay in the setting of the rail, since after vertical movements it would not be parallel with the table. After making adjustments on the elevating screws and always taking pains to position the rail by having the weight down, still, a movement could not be depended upon to leave the same paralellism there again.

Finally, the plan adopted was to place the rail at the approximate height desired, and there to level it with the ways, the table being run off for the purpose. Then two holes were drilled, one on each side, through the extended bearing of the rail on the housing and into the flanged inner part of the housing. The sketch shows the arrangement. These holes were reamed to No. 3 Morse taper, and dowels were made to fit. Removal nuts were put at the large end of the taper. With these dowels, a correct setting is possible in a very few minutes.

If a defense of this plan is necessary, it might be said that the work requiring such accuracy was all within 3 in. of the same height, and thus it was possible to make the one pair of holes answer for a good part of the work.

After putting in the dowels, a light cut was taken over the table to bring its top parallel to both the ways and the travel of the heads. This improvement has done away with all uncertainty and checking, the latter having been formerly found necessary every time a close job was run off. It was a slow task, since the head movements from one end of the rail to the other all had to be made by hand. Another source of inaccuracy had been from the rail's shifting a little under a heavy cut, or when the cut had run out on to the scale of a casting, and the wedging action had forced one end of the rail up slightly against the friction of the clamping bolts.



Rail pinned to housings

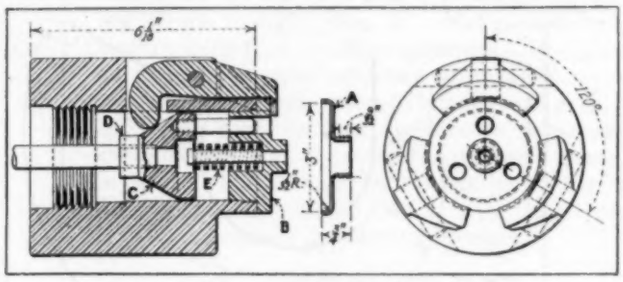
For angular work it was found advantageous to put dowel holes in the swivel heads. The number of cuts

taken at 22½ and 30 deg. made it worth while to drill and ream at these points, not depending upon the visual setting. The holes in the heads were finished with a No. 9 taper-pin reamer. Like the other doweling, the one on the heads saved a good deal of time in trials and checking.

Threading Fixture With Ejecting Attachment

By L. L. Locke

The sheet-metal cap shown at *A* in the illustration requires turning, facing and threading after being drawn to the shape shown. The operation is handled in a turret lathe in which the fixture illustrated is utilized.



Stub fixture equipped with ejector

Three jaws, equally spaced in the body, grip the work after it has been placed on the centering plate *B*. Movement of the jaws is actuated by the tapered plug *C* attached to the draw bar. Horizontal adjustment of the plug in relation to the jaws is made by screwing the draw bar in either direction, and the collar *D* locks it in place. The centering plate is hardened and ground on the outside diameter, front face and smaller diameter, so that the work fits it snugly.

Ejection of the work is accomplished by three studs, located in the tapered plug, which strike the inside surface of the work when the plug is moved outward. The helical spring *E* forces the plug back after ejection, so that the pins will not interfere with reloading of the fixture.

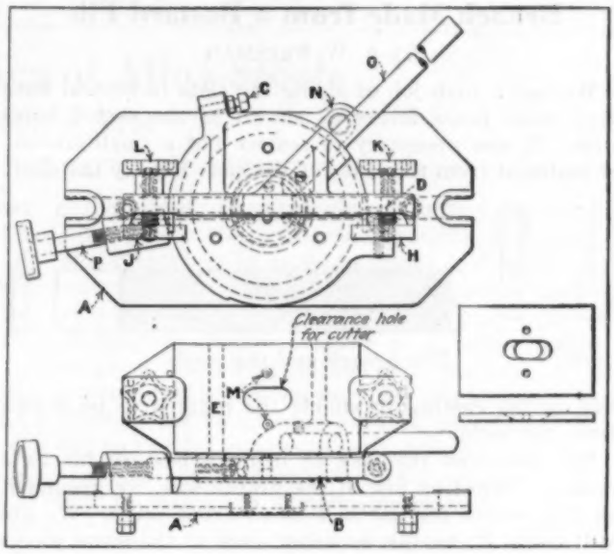
Fixture for Milling Radial Slots

By Edward T. Heard

In connection with our regular production, it was necessary to finish-mill cored slots having radial ends, in quantities of Micarta blocks. The fixture designed for the work is shown in the illustration.

The base *A* is tongued to fit the slot in the machine table. The fixture proper, *B*, swivels on the base, its motion being limited by the adjustable stops *C* and *D*. The work is held on the upright plate *E* by the clamps *H* and *J*, operated by screws and the hand knobs *K* and *L*, and is located by the pins *M*, which engage holes previously drilled. In loading, the fixture is rotated until the stop pin *N* on the lever *O* is brought against the adjustable stop *C* and is clamped by the screw *P*.

In operation, the work is fed so that the cutter passes through one end at an angle. It is then withdrawn from the cutter and the clamp is loosened. The fixture is then rotated until the stop pin on the lever contacts with the adjustable stop *D*. The fixture is



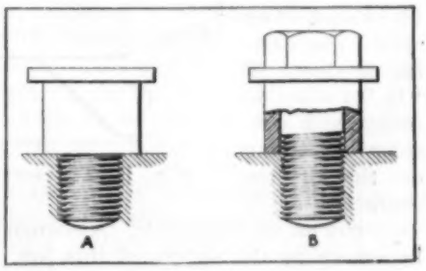
Slot-milling fixture

clamped in this position and the work is fed over the cutter as before. Without withdrawing the cutter, the fixture is unclamped and is rotated until the stop pin on the lever is again in contact with the stop *C*, thus completing the slot. To smooth the slot, the fixture is rotated in the opposite direction.

A Suggestion for Machine Designers

By R. H. Kasper

When an arm or lever is to be swiveled upon a stationary part of a machine, the shouldered stud shown at *A* in the sketch is the means usually adopted by machine designers to accomplish the object. Compared with the arrangement shown at *B*, however, the greater cost of the stud can readily be realized, especially from the standpoint of replacement. Yet both are equally effective in service. The argument may be advanced that the greater height of the screw and bushing may be objectionable. This may be so at times, but if the stud is to be drawn up tightly, the head of *A* must be made high enough to provide a firm grip for a wrench. If the head be slotted for a screwdriver, the stud cannot be drawn up tightly enough to withstand severe service, and after a screwdriver has slipped out of the slot a few times the slot is rendered practically useless.



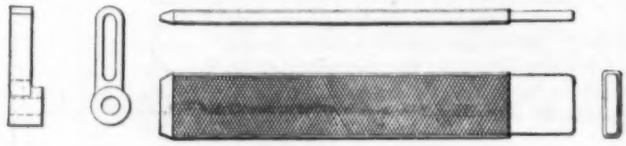
Shouldered stud vs. screw and bushing for swiveling joints

Another point that might be argued against the construction shown at *B*, is that the part may not be located so exactly with reference to the threaded hole. This need not be true if the bushing at *B* is made a close fit for the blank part of the screw, which should extend nearly through the bushing. In case of replacement, it is much cheaper to make a new bushing than a new stud.

Broach Made from a Bastard File

By A. W. Freeman

We had a rush job of sizing the slots in several hundred small brass levers as shown in the sketch herewith. It was necessary to remove but a small amount of material from the sides of the slot; namely the draft



The broach and the work

left on the casting to enable the pattern to be drawn from the mold.

We conceived the idea of using a bastard file as a broach. Selecting one of the proper size, we ground it as here shown for use in a small arbor press. We are still using it, having broached several thousand pieces with it, and we no longer consider it a temporary tool.

Interchangeable Cams

By C. H. Van Fossen

In the regular run of work in our drilling department, we have considerable quantities of bolts and clevis pins requiring cotter-pin holes. For this work, we have a horizontal five spindle automatic drilling machine of a standard make. It is not busy full time, however, on this work. We have also a heavy production on a small malleable casting having a $\frac{5}{32}$-in. hole drilled through two ears. The casting is shown in Fig. 1. Estimates indicated a considerable saving on the drilling operation if it were run on the automatic. A change of cams was made necessary by the nature of this job. The camshaft at the rear of the machine has its driving gear and five feed cams spaced between solid bearings in ribs cast on the bed of the machine. The space for cams is somewhat restricted. We wanted to change cams for the different jobs without dismantling the whole feeding mechanism. We replaced the original cams with five driving sleeves, or hubs, one of which is shown in Fig. 2. The body *A* is pinned permanently on the camshaft and has a recess bored in the face of the larger diameter. The driving block *B* is dowelled in position and has a shoulder fitting into, though filling but part of, the recess in *A*. The cam for drilling the malleable casting is shown in Fig. 3. It is cut out to slip over the smaller diameter of the driving sleeve *A*, Fig. 2, and has a shoulder which enters the part of the recess not filled by *B*, and locates it centrally on the camshaft. The driving block *B* drives the cam and fills out its circumference as indicated by the dotted line in Fig. 3, this portion being the idle time during which the drill spindle is back.

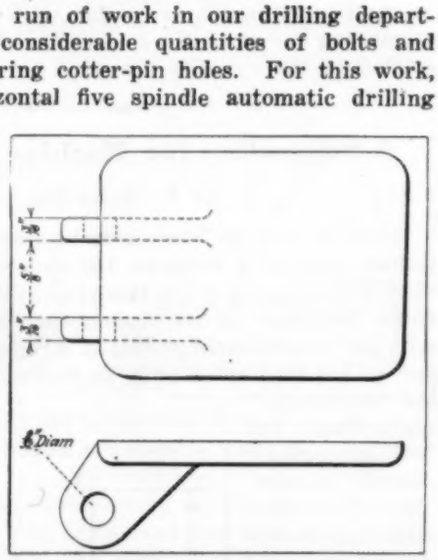


Fig. 1—The work to be drilled

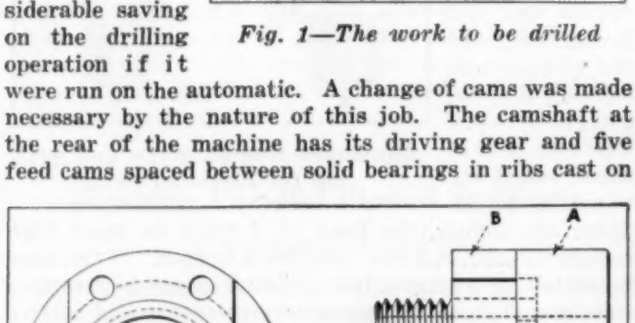


Fig. 2—One of the driving sleeves

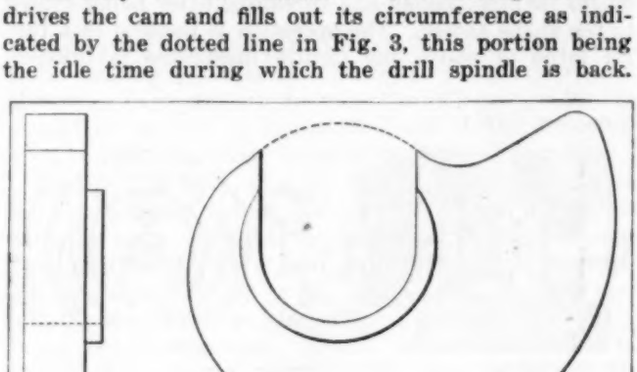


Fig. 3—Cam for drilling the work in Fig. 1

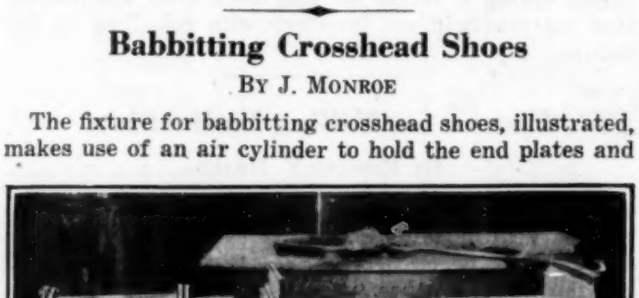
Nut *C*, Fig. 2, clamps the cam in position, and it is necessary only to run it back far enough to let the shoulder on the cam out of the recess to take the cam off the shaft.

Cams having a constant rise through three-fourths of their circumference were made to replace the original ones for drilling bolts and pins. The set of five cams can be changed in a very few minutes.

Babbitting Crosshead Shoes

By J. Monroe

The fixture for babbitting crosshead shoes, illustrated, makes use of an air cylinder to hold the end plates and



Air-clamping fixture for babbitting crosshead shoes

their asbestos linings against the ends of the shoes. A block of wood is the babbitting mandrel.

This device is in use in the Las Vegas, Nev., shops of the Union Pacific System.

Characteristics of Alloy Steels

Manganese Steel

All commercial steels contain some manganese, but the term manganese steel is ordinarily applied only to the steels containing from 10 to 15 per cent of manganese, although other "low-manganese" steels are on the market. Manganese steel, as developed by Hadfield, was one of the first of the alloy steels, and still has a wide field of use.

Manganese is a grayish-white metal with a reddish luster. It takes a high polish, but is brittle, not malleable, and has no commercial use alone. Its melting point is 2,237 deg. F. Manganese will alloy readily with iron in all proportions. It makes steel hard, but the chief property of manganese steel is toughness. A proportion of manganese even as low as 1 per cent renders steel more tenacious. In amounts less than 1 per cent manganese is employed in steel as a scavenger because of its strong affinity for oxygen and sulphur. When more than 1 per cent is used it becomes an alloying element.

Effect of Manganese

Manganese increases the hardness and tensile strength of steel. In the absence of carbon, manganese up to 1.5 per cent has slight influence on iron, but as the carbon content increases the effect is intensified. Structural steels containing 0.50 per cent of carbon, and from 1 to 2 per cent of manganese, have physical properties similar to nickel steels of the same carbon content, but having twice the proportion of nickel.

Low-manganese steels with from 1 to 2 per cent of manganese, and with varying percentages of carbon, have been employed with success for many uses, including forgings, castings, ordnance, shear blades, and rails. The "non-deforming" tool steel used for dies usually contains about 1.5 per cent of manganese. The low-manganese steels are heated slower and with more care than carbon steels, and they are hardened at slightly lower temperatures than carbon steels of the same carbon content. A manganese steel containing 3.20 per cent of manganese and 0.34 per cent of carbon, quenched in water and tempered at 800 deg. F., showed a tensile strength of 158,000 lb. per sq.in. and a Brinell hardness of 250. Medium-manganese steels are very brittle, and manganese contents between 2 and 9 per cent are not ordinarily used for commercial steels.

The bulk of manganese steels contains between 11 and 14 per cent of manganese with a carbon content of about 1.20 per cent. One of the greatest uses of this class of steel is in castings for machine parts subject to extreme wear and abrasion. It is also rolled or forged. Outstanding uses of manganese steel are for the teeth of steam shovels, crushers, rolling mill gears, and tractor treads.

The chief characteristics of manganese steel are high tensile strength, great resistance to wear and shock, increase in hardness under cold work, and absence of magnetism. It does not possess the corrosion resistant properties of chromium or nickel steels. Manganese steel is valuable as a facing for lifting magnets because of its non-magnetic quality. Manganese steel is not commercially machinable. In machining, the metal work-hardens under the tool, and the second cut is always more difficult than the first. It can be nicked readily with a chisel, but it is difficult to make any further impression.

Forging and Casting

The fact that manganese steel cannot be machined has largely limited its use to the forged or cast state. Hot working improves the properties of the steel, and a proper heat treatment is necessary, since the metal is very brittle and almost valueless in the cast condition. The quality of hardening under cold work makes manganese steel especially valuable for such uses as the teeth of steam shovels, and a manganese-steel shovel will last longer when handling hard stones than when digging in finely divided hard materials. Another valuable characteristic of the steel is that cracks when started do not spread rapidly even under impact.

Manganese steel is made in any steel furnace, but it is claimed that the best metal is produced in the electric furnace because of the complete deoxidation. The steel contracts in cooling about twice as much as ordinary steel, and this must be taken into consideration in making the patterns. Since the cast steel is very brittle, and rapid cooling in the mold is likely to cause cracking, it is usual to take care of this factor in the design by putting supporting ribs on weak sections. This obviates the need of taking the hot casting out of the mold and cooling in an oven. If necessary, these ribs are later broken off.

Heat Treating

The heat-treatment of manganese-steel castings consists of heating the steel to approximately 1,800 deg. F., and then cooling rapidly in water. If the cooling is too slow the precipitated carbides will decrease the toughness of the steel. The use of manganese-steel castings is therefore limited to sizes that are capable of being cooled rapidly.

The castings should be removed from the quenching bath while they are warm, that is, at a temperature of about 400 deg. F. This will relieve the cooling strains, and no further draw is necessary. However, a separate draw, at not over 700 deg. F., may be given. After heat treatment manganese-steel castings will ordinarily be clean and free from sand and scale.

For the information given we are largely indebted to the A.S.S.T., U. S. Bureau of Standards, and to the manufacturers

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Practical Shop Problems

Questions of a Practical Nature will be answered in these columns

Indicating Pattern Parts

Q. Will you please tell us if there is any standard way of showing the location of loose pieces on patterns if these pieces happen to be removed from the pattern in the storeroom?

A. According to standards adopted by the American Foundrymen's Association, seats for loose pieces on the pattern are painted with red stripes on a yellow background. Core prints and seats for loose core prints are painted yellow. Stop-offs are indicated by diagonal black stripes on a yellow base.

Polishing Small Surfaces

Q. We have considerable rubbing and polishing to do on japanned surfaces, and would like to know if there is any mechanical method to replace the hand operations. Due to the small areas of surfaces on our parts we have not been able to employ the so-called rubbing machines used in automobile polishing.

A. This matter has been the subject of much experimentation for a number of years, and we do not know of any mechanical method that has been developed to replace hand polishing for the highest grade of japanned surfaces. The rubbing machines are very successful in places where there is considerable area, but we agree that they may be impracticable for small intricate parts. However, a good polish can be obtained with a small rotary brush or felt wheel on a flexible shaft, and it is possible that you can use this method supplemented with a final hand polishing.

Lubricating Silent Gears

Q. Can you recommend an oil or grease for use on silent gears that will not soften or injure the material in the gear?

A. The type of grease to use depends somewhat upon the material in the silent gears, but we believe that any good graphite grease will give good service. One maker of silent gears recommends a stiff paste of graphite and machine oil. It is well to remember that silent gears in general require as much regular attention to lubrication as do all-metal gears.

Tools for Turning Aluminum

Q. We have a number of aluminum rolls to turn, and a discussion has come up as to the type and kind of tool that will give the best results.. Will you please let us have any available data on this subject?

A. The general rule in turning aluminum is to grind the tool as for cutting a soft machine steel. The top rake should be a 25- or 30-deg. angle to the right, and about 15 deg. to the rear. The cutting corner should he well rounded, and the face of the tool should be backed off a little from the work.

Use high-speed steel tools for the roughing cut, but you are likely to get better work in finishing with carbon-steel tools. A roughing speed of about 500 ft. per min. is a good average, with about 150 ft. per min. for finishing. It is a good plan to employ a lubricant on the finishing cut. Kerosene is used with success for this purpose.

Preheating Bearings for Babbitting

Q. Is there any advantage in preheating bearings before babbitting? What temperature should be employed?

A. Cast-iron bearings should be preheated to a temperature of about 450 deg. F. before babbitting. This heating will eliminate chilling of the babbitt, and will allow it to flow freely close to the cast iron, thus preventing loose babbitts due to unequal shrinkage.

Seasoning Precision Gages

Q. Can you furnish us with a description of the methods employed in "seasoning" the steel in precision gages?

A. The "seasoning" operation on precision gages is accomplished after rough grinding the hardened gage. The method employed at the Bureau of Standards is to dip the gages in boiling water and in ice water alternately about 30 times.

The gages are held in the boiling water and in the ice water long enough to insure that their temperature has been raised or lowered to the temperature of the bath. The difference in temperature between the two baths is 180 deg. Experiments have shown that after these successive heating and cooling treatments the gages do not alter their size or shape with ordinary temperature changes.

Flux for Brazing Steel

Q. We have the job of brazing on a lot of steel tubes. Borax was recommended as a flux, but does not give results. What can you recommend for this purpose?

A. Borax can be used as a flux, but is likely to froth and cause trouble due to the large amount of water contained in the crystals. Boracic acid will give much better results as a flux, because it does not have a water content.

Making a Soldering Flux

Q. Will you please give me a formula for a good soldering acid?

A. The best known "soldering acid" is made by "killing" hydrochloric acid with zinc. Take a quantity of undiluted hydrochloric acid and add zinc until no more of the metal will dissolve. The acid is then ready to use as a soldering flux.

Technical Abstracts

Music Aids Manufacturing

The fact that loud speakers had to be tested in one part of the Newark works of the Westinghouse Electric and Manufacturing Co. led employees in other departments to ask for music also. Now nearly every division has its own phonograph and loud speaker with one of the workers acting as "music master." Comparative quiet exists in this plant, where electric meters are made, so that conditions were almost ideal.

The conclusions drawn from this experiment were that music offsets monotony, fosters contentment, helps overcome the droop of spirits during the afternoon, and is a partial antidote for fatigue.—H. E. Miller in *Manufacturing Industries*, October, 1926, p. 249.

The Value of Industrial Training

The untrained man who starts in the shop at 14, and has a common school education, reaches a maximum earning power at 30 years of age. His total earnings from 14 to 60 are about $45,000. The high school graduate goes to work at 18, but passes the untrained man and rises to his maximum at 40. His total earnings from 18 to 60 are about $78,000. The technical college graduate begins to earn at 22, but there is no limit to his earnings and these increase with the years. The total earnings from 22 to 60 average $150,000 for the technical graduate.

The value of apprenticeship training lies somewhere between the high school graduate and the college graduate's earning power. Education is invaluable, and the day is fast approaching when the number of so-called self-made men is diminishing. With the demand for the trained man by industry it can easily be seen that the management of the future will more than ever before be in the hands of men trained in schools rather than in the school of experience.—F. W. Bacon, in the *Open Shop Review*, Nov., 1926., p. 428.

Holding Power of Wood Screws

Tensional tests on more than 10,000 wood screws in seven different kinds of wood were made by the Bureau of Standards to determine the conditions contributing towards maximum holding power.

It was found that the size of the lead hole is important, and should be about 70 per cent of the root diameter of the screw, or about 90 per cent in hardwoods. A lubricant, such as soap, may be used on wood screws without great loss in holding power.

In choosing between two adequate screws, the smaller diameter and longer length should be used when possible. For a given length of screw the holding power increases with the diameter to a fixed limit beyond which an increase in diameter decreases holding power. For a given diameter of screw the holding power increases with the length to the limit where in hardwoods the metal of the screw fails in tension.

In the design of wood joints a sufficient number of screws should be used to make the fastening as strong as the wood where splitting does not prevent. In cases where holding power is especially important screws should be selected that have thin sharp threads, rough unpolished surfaces, full diameter under the head, and shallow slots.—I. J. Fairchild, in *Technologic Paper No. 319*, 1926, U. S. Bureau of Standards.

A Thought for Machine Tool Builders

The railroads have been criticized for being slow to adopt new methods and modern machinery, yet it has been pointed out that this apparent lack of appreciation of modern equipment has not been due entirely to lack of progress on the part of mechanical officers, but to a great extent to the fact that limited appropriations often make necessary a severe curtailment of new machine tool installations. Relatively, there is no doubt that the automotive field has offered a more extensive and profitable market to the machine tool builder, but, under present conditions, is it not reasonable to suppose that the railroads may offer an increasingly profitable market in comparison to the automotive shops? The rapid development of automotive equipment and the expansion of plants has made it necessary for the machine tool builder constantly to bring out new machines in order to supply the demands of present day production. Is it not possible that the less rapid progress on the part of railroads in rehabilitating their plants has been due to the fact that relatively little effort has been made on the part of the machine tool builders to develop machines particularly suited to the class of work that a railroad shop must perform? In all too many cases the effort has been made to sell to the railroads machine tools designed primarily for production work—a type that has a very limited field in the railroad shop.—*Railway Mechanical Engineer*, Nov., 1926, p. 650.

Integral Cylinder and Frame Casting

A steel casting has been made for the Terminal Railroad of St. Louis, in which the cylinders, steam chests, deck frames, cross bracing, saddle and the bumper beam are combined in a single unit. The casting is said to take the place of thirty parts as usually made, and to be 6,500 lb. lighter and four times as strong.—*Railway Age*, Oct. 30, 1926, p. 848.

Electric Annealing of Magnetic Materials for Telephone Apparatus

About 8,000 pieces of apparatus of regular manufacture are used by the Western Electric Co. to perform electro-magnetic functions. Therefore, they must be annealed. They give a net load of about six tons per day. About five tons of small parts are annealed daily.

Equipment formerly used consisted of oil-fired furnaces of the single door type 7 ft. 6 in.x26 ft.x18 in. inside dimensions, each heated by a single oil burner with temperature controlled by manual adjustment. Three operators were required for the loading operation, carried out by means of an air hoist. Hot pots were unloaded by the same method and allowed to cool on trucks. Discomfort to the operator was objectionable as it was difficult to control temperatures.

Parts to be annealed were placed in pots and cast-iron chips were shaken down to fill the spaces between the parts. Sheet-metal covers were used. This arranging necessitated screening and sometimes hand brushing after annealing.

Electric furnaces of the car type have replaced the oil-fired furnaces. Doors are raised and cars are moved through the furnace by means of compressed air. There are two tracks through the furnace and the cars on them move in opposite directions, a feature essential to recuperation. The first zone of the furnace is a pre-heating and cooling chamber, the second is a heating chamber and the third is another pre-heating and cooling chamber. In their journeys through the furnace a cold car going into the furnace stands for a period opposite a hot car about ready to come out. By this arrangement the cold car is pre-heated.

When a car leaves the furnace it has a temperature of about 700 deg. F. It is placed under a cooling hood which is pulled down over a stack of pots to the car top. The hood is provided with a motor-driven fan which exhausts the heated air to the exterior of the building. A total of 23 hr. is required to complete an annealing operation.

Approximately 158 kw. at a pressure of 440 volts with 3-phase connection are supplied for the battery of furnaces.

Annealing pots of heat-resisting alloy are used. No packing material is required.

The electric furnace has been found to be more economical than the old equipment. Heat is saved and only one operator is used. Labor has been saved in packing and unpacking pots. Repair charges have been small. The quality of the annealed product has been improved.—W. A. Timm, in *Transactions of American Society for Steel Treating*, November, 1926, p. 782.

American Machinist

KENNETH H. CONDIT AND FRED H. COLVIN
Editors

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Machine Tool Standardization

ELIMINATION of unnecessary sizes and adoption of a uniform tool-holding element are two forms of machine tool standardization, the value of which is obvious. Both maker and user profit, the maker because he makes fewer types of parts or complete machines and therefore can build in larger lots, the user because one set of tools can be used on several machines, and because he can get a standard machine at a lower price than a special one.

The decision of machine tool builders to put these two forms of standardization, or simplification, into effect is to be commended. It is a big step forward even though the foot has been in the air for more than a score of years since William Lodge urged this very action at a machine tool builders' meeting.

Seaplane Speed Records Go to Italy

THE Schneider Cup goes to Italy for a year. Major Mario de Bernardi made a new record of 246.49 mi. per hr. with a Macchi Fiat 800-hp. monoplane. Later he flew 258.87 mi. per hr. over a 3-kilometer course beating the former record by over 13 mi. per hr. This was an average of four laps, two against and two with the wind, the fastest being 272.58 mi. per hr.

While racing planes, like racing cars, are not commercial products, they have a bearing on the progress of the art. The Fiat planes had nominally 100 hp. more than the Curtiss, used by the Navy, so the superiority of monoplane over biplane is by no means clear. The fact that what was supposed to be the fastest Navy plane was cracked up before the race does not detract from the glory of the winner. May aviation progress continue and every advance be reflected in the plane for commercial use!

Cutting Down the Power Wastes

MANY factory executives are still treating power and the transmission of power as side issues of little consequence. Yet it is claimed that an amount in dollars equal to one quarter of the entire payroll of American industry is paid out annually for power. In many otherwise efficient plants today the close attention of management can be turned profitably to a more effective use of power with consequent economy in its production and distribution.

In a smoky mid-western city, where the public is almost reconciled to the idea that the burning of low grades of soft coal means eternal smoke, one of the large automobile manufacturers has clean carpet runners between the power house boilers, and exhibits a nickel-plated ash barrow that is never used, to show that the plant has conquered the fuel wastes.

Proper selection of individual or group drive, elimination of excessive over-motorizing of machines, attention to belting, loose pulleys, and other transmission details, are a few of the points where good management can save money. Wasted power usually brings with it a waste from excessive wear on equipment in addition to the direct money loss from unused power. The possibilities of saving are worth consideration.

Tool Engineering

TOOL engineering is responsible, to a great extent, for the vast advances that have been made in high-production manufacture. In reality, it can be called a science that has been developed within the past thirty years. Perhaps an idea of the value of tools can be gained easily by imagining the manufacturer of an automobile engine without the aid of jigs and fixtures. Then, if it were not for the efficient tooling devised to handle repetition work, much of the machinery being marketed today would not be warranted. One without the other would be of little value.

In one sense, strict interchangeability is impossible, but tooling has done more toward reaching the goal than any other contribution. Therefore, this art can be considered a valuable asset in the manufacture of mechanical units. Tool engineering has not reached its height. New developments, or inventions as they can be termed, are being brought out continuously which far surpass previous methods that in themselves were considered the last word. Press tools, for example, have made a remarkable advance that is evidenced by the increasing number of parts being made in a press today which, a short time ago, would have been considered an impossible undertaking. Pressed-steel parts have been substituted for castings in many cases and there still seems to be room for improvements in this type of tool.

Standardization, by individual manufacturers, of tool design, such as applied to jigs, fixtures and dies, is a contribution that has made possible a substantial reduction in tool cost, and has stimulated the use of tools for parts that heretofore were not made with tools.

Shop Equipment News

Boeger-Meyer Automatic Tapping and Drilling Machine

The automatic tapping and drilling machine shown in Fig. 1 has been developed by Boeger-Meyer Machine & Tool Co., 61 McWhorter St., Newark, N. J., for production work. In the set-up pictured, four previously-drilled holes are being tapped $\frac{7}{16}$ in. deep in cast iron with a No. 10 tap, 32 th. per in. Twenty-five pieces are completed per min., or 1,500 per hr. When the machine is used for drilling, about 1,000 pcs. per hr. are finished. Four spindles are used in this unit, but any number from one to six can be obtained with this machine. A feature of the machine is a feed conveyor of the endless-chain type. The operation is entirely automatic, being controlled by cams, and the only function of the operator is to load the feed belt.

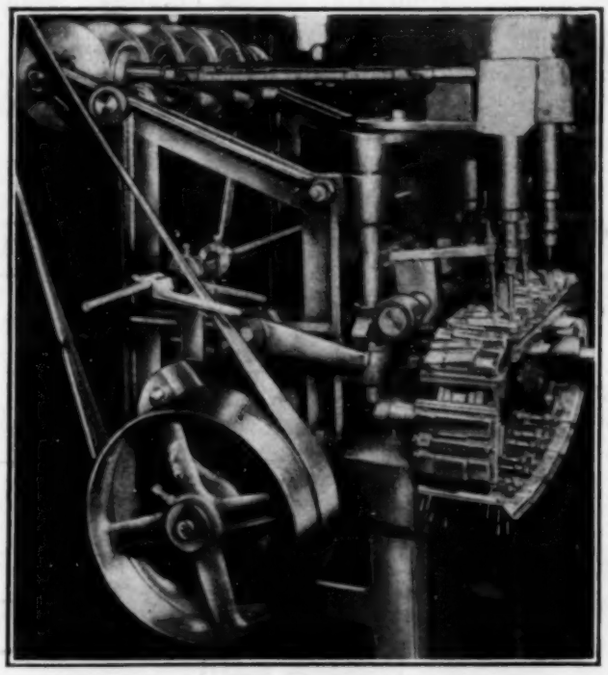


Fig. 1—Boeger-Meyer Automatic Tapping and Drilling Machine

The operation of the machine is as follows: The four spindles descend simultaneously, together with spring-floating holding plungers that clamp on four pieces. One hole is tapped in each piece but at different corners. At the completion of the tapping, the spindles are reversed and the taps back out. At the same time the head carrying the spindles is raised. The conveyor then moves forward one position, and the cycle repeats.

The conveyor is of the endless-chain type, consisting of fourteen linked plates as shown in Fig. 2. Fastened to each of these plates by means of two cap screws are a like number of adapter plates having eight locating pins that are positioned according to the shape of the piece being tapped. Different sets of adapter plates can be stocked to suit various parts being worked upon. Four plates are presented to the spindles at a time and are supported underneath by a substantial plate. Movement takes place only when the holding-down pressure is removed; hence, only the weight of the parts is dragged across this bedplate.

The conveyor chain is carried around two sprockets, one of which is driven intermittently by means of a Geneva stop mechanism, driven, in turn, from the countershaft of the machine through bevel gears.

The spindles are each driven by means of a pair of friction disks, one for forward motion, the other for reverse. Engagement of the disks is by a friction wheel, the relative position of which can be varied to obtain a moderate variation in speed of the spindles. Simultaneous shifting of the friction disks to obtain reversal is accomplished by means of a cam, which has a lobe that can be shifted about to suit the particular work being handled.

From each friction wheel the motion is transmitted to a corresponding spindle by means of a telescoping shaft with universal joints at each end. Each head is mounted on a pivoted and slotted sector so that the position of the spindle can be adjusted to cover any point within the area of the feed plate. The four sectors, in turn, are carried on a single head supported on two vertical bars, sliding in bearings so that the head can be moved up or down. This movement also is controlled by means of an adjustable cam operating through a bell crank. Integral with this lifting frame is a bar carrying four holding-down plungers that bear against the parts being tapped. Springs are employed to limit the pressure applied and to avoid shock when the plungers are dropped on the work.

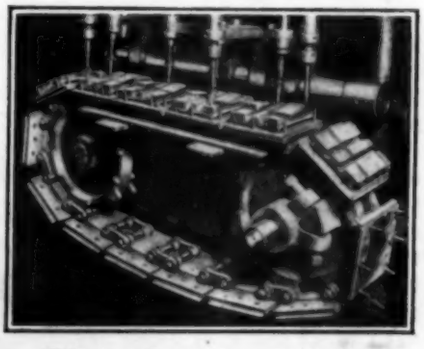


Fig. 2—Conveyor mechanism

The chucks holding the taps have a vertical float of about 2 in. so that all danger of forcing the tap either in or out is avoided. The head is dropped and also raised its full travel almost instantly, but the tap travels into or out of the work at its own independent speed.

The machine shown is belt-driven. The mainshaft has a tight-and-loose pulley mounted at one end, and at the other a large pulley drives the friction-cone shaft at the upper rear of the machine. Integral motor drive can also be supplied at the option of the purchaser.

Shop Equipment News

Oliver No. 144 Hand Planer and Jointer

The Oliver Machinery Co., Grand Rapids, Mich., is building the No. 144 planer and jointer shown in the accompanying illustration. Its rated capacity is 6 in., but it is not a portable machine and is intended for production work. It is built both in bench type or mounted on a suitable pedestal.

The bed is cast solid with the two columns and the ball bearing housings. It carries on 60-deg. machined dovetail bearings the inclined ways that support the tables. The design of the bed is such that efficient shavings exhaust is provided.

The tables are made of cast iron with removable steel lips at the cutting throat. Each table is 6½ in. wide, the front one being 24½ in. in length while the rear one is 15½ in. in length. Both tables have dovetailed inclined ways, hand scraped for perfect bearing and ease of movement. Each table is independently adjustable toward and away from the cylinder by means of a knurled hand wheel and steel screw, and for rabbetting up to ½ in. deep. Two locking screws for each table located at the front of the machine are provided. The lips are shaped concentric with the cylinder so that the tables can be drawn to the minimum opening of cylinder throat. This construction is said to insure a higher quality of work, capacity for handling shorter stock, and maximum safety to the operator.

The cylinder is the so-called Oliver "Circular Safety" type made of forged steel and of patented elliptical design for clearance of shavings and smoothness of cut. The cylinder is mounted on double row self-aligning ball bearings, lubricated by grease. It is furnished in either two- or three-knife type as specified and carries special tungsten-chromium thin steel knives and adjustable chip breakers. The cylinder has a cutting diameter of 3⅜ in. and is machine ground for balance.

For belt drive, a pulley 2¼ in. in diam. and 2¾ in. face is provided, crowned and grooved with wide flanges. Proper speed for the three-knife cylinder is approximately 3,600 r.p.m., while for the two-knife cylinder it is approximately 4,500 rev. per minute.

The machine is regularly equipped with the "Oliver" aluminum automatic knife guard as an additional feature of safety to the operator. This guard is automatic in movement and always covers that part of the knives not actually cutting. It is substantial in design and swings on a stud fastened under the rear table with a spring and adjustable rubber tipped bumper for return movement.

Oliver No. 144 Ball Bearing Hand Planer and Jointer

The fence is 24 in. long, 3½ in. wide and is rigidly mounted and planed true. It can be tilted and locked at any angle from 90 to 45 deg. It can also be moved anywhere across the table.

Three distinct types of motor drive can be furnished: Direct motor-on-cylinder shaft drive, as illustrated, is furnished only for 2- or 3-phase, 60-cycle, 220-volts, alternating current. This is a standard 3,600 r.p.m. shaftless motor mounted directly on the extended shaft to the cylinder head. A direct coupled motor drive is furnished for 1-, 2- or 3-phase, 60-cycle, 110- or 220-volt alternating current, or direct current. This is a 3,600 r.p.m. motor mounted on a special bracket bolted to the machine bed and coupled directly to the cylinder shaft through a flexible coupling. Lastly a belted motor drive is furnished for any current specifications. The motor is mounted on a bracket bolted to the machine column at the rear and having sliding rails for taking up the belt slack. A wire mesh guard for the belt can be furnished if desired. In any case, the motor furnished is from ½ to 1 hp., depending upon the kind of work required of the machine.

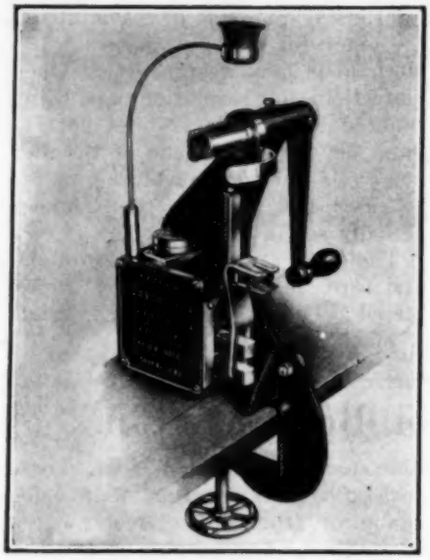
The bench model occupies a space of 18x41 in. and weighs 300 lb. crated. The same space is used when the machine is mounted on the floor column; the weight is 500 lb.

"Duplex" Traction Dynamometer for Testing Diamond Wire-Drawing Dies

The "Duplex" traction dynamometer, shown in the accompanying illustration, for use in testing diamond wire-drawing dies, is being built by Robert Miller, 4725 Lancaster Ave., Philadelphia, Pa. This instrument is designed for attaching to a bench.

The outfit consists of a winding

Shop Equipment News



"Duplex" Traction Dynamometer for Testing Diamond Wire-Drawing Dies

drum, operated by means of a crank, a suitable frame for holding the diamond wire-drawing die, and a spring balance for registering the tractive force in pounds. To operate the instrument, the die is inserted in the machine and a few feet of wire is then taken and the end pointed by means of a wire pointing stud mounted on the frame. About a foot of wire is pulled through the die by means of pliers. The end of the wire is given a turn around the winding drum. The crank is then turned until the wire is completely drawn through, during which time the tractive force on the wire is read on the indicator directly in pounds. The wire is then fed to a special bobbin provided for this purpose and the bobbin is placed in the die holder. The crank is then turned slowly until the wire breaks. The indicator reading is noted.

A magnifying glass suspended over the instrument can be used for examination of the wire.

Two ranges of measurement are provided. When the traction is less than 15 lb., the die holder is removed from the lower projecting beam and placed under the upper one, which has a capacity one-tenth the lower.

Sleeper & Hartley Nos. 3½ and 4½ Universal Spring Coilers

Two additional sizes of universal coiling machines, Nos. 3½ and 4½, have been placed on the market by Sleeper & Hartley, Inc., 335 Chandler St., Worcester, Mass. In Fig. 1 is shown a front view of the No. 4½ machine, and in Fig. 2 is shown the operating mechanism on the rear.

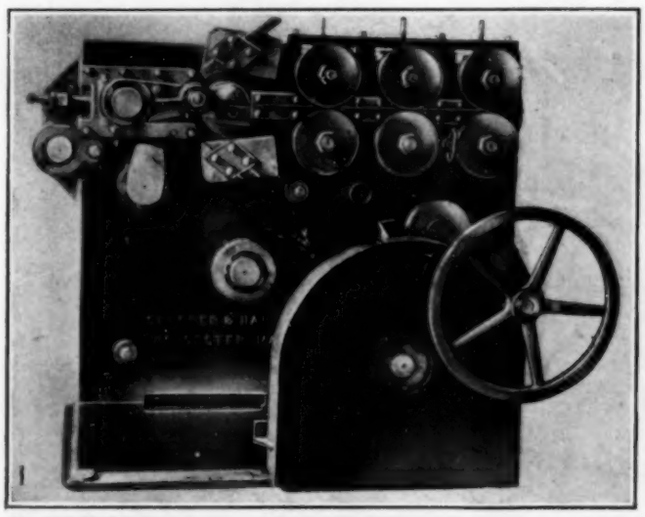
The universal coilers are designed for making all kinds of compression springs of round wire without tool changes. Extension and close-coiled springs may also be coiled and cut on the machines. The range of the No. 3½ machine is for wire from No. 12 gage to ¼ in., and that of the No. 4½ machine is for wire from No. 8 gage to ⅜ in. The various spring forms are handled by merely adjusting the working members of the machine. Resetting of the machine for changes from one spring to another is claimed to be made in 10 to 20 minutes. Additional equipment will enable the machine to handle square or rectangular wire.

The No. 3½ coiler will feed and cut springs up to a maximum of 84 in. of wire, and the No. 4½ machine will produce springs containing 130 in. of wire. The maximum output of the smaller machine is 20 springs per minute, and that of the larger machine is 30 springs per minute. The machines will coil right and left hand springs, produce coned springs with any degree of taper or with variable pitch, make barrel springs, or will taper one end or both ends.

The floor space occupied by the No. 3½ machine is 42x56 in., and by the No. 4½ machine 64 in. by 70 in. The small machine weighs 3,850 lb., and the larger weighs 9,800 pounds.

Viking Revolution Stop Counters

A revolution stop counter involving several original design features has been placed on the market by the Viking Tool & Machine Co., 745 Sixty-fifth St., Brooklyn, N. Y. It is for use in automatically stopping a machine after a predetermined number of revolutions, ranging from 1 to 9,750, have been made. The device is particularly applicable to



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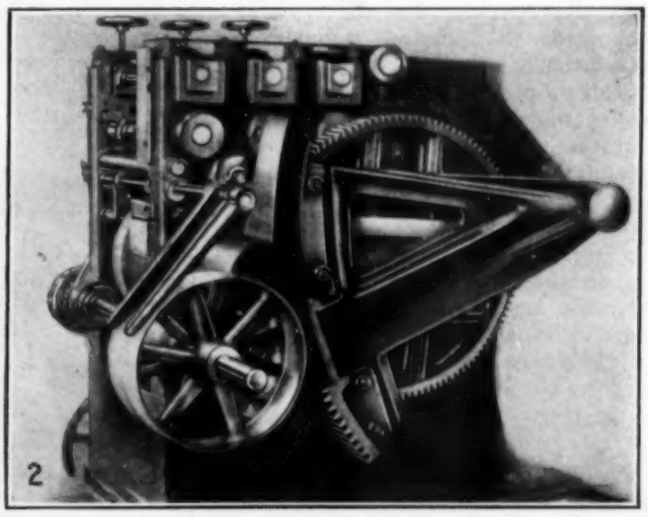

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Fig. 1—Sleeper & Hartley Universal Spring Coiler. Fig. 2—Rear view of spring coiler

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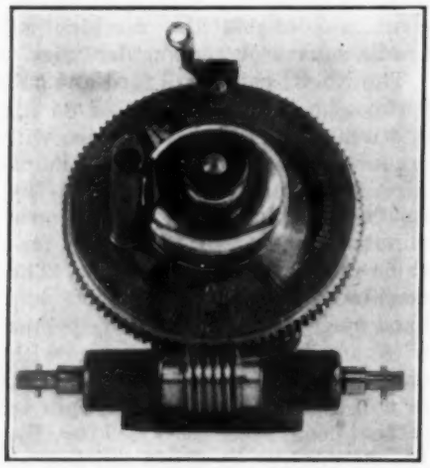
various types of coil-winding machines where a fixed number of turns are to be wound, for linear measuring machines, power presses, screw machines where a limited production is required, chemical mixing machines, textile and print machinery.



Viking Revolution Stop Counter

A patent has been applied for this device.

Four styles of counters are made, of which the electrical-contact type is illustrated. In this particular device, also, a bell is rung an instant before the machine is stopped, and the stopping is accomplished by a make-and-break electrical contact that operates a suitable relay. A second type of counter is equipped with a mechanically operated lever, by means of which clutches can be operated for stopping the machine. A third style operates a bell or other signal, which is merely actuated to warn the operator that the machine has made the required number of revolutions. The fourth style constitutes a plain counter, by means of which the number of revolutions or strokes made by a machine can readily be determined through observation. This last style of counter is limited to 9,900 revolutions, and by means of suitable gearing between the device and the rotating member any reasonable number of revolutions above this can be counted.

The device consists essentially of a driving worm and a split wormwheel consisting of two disks. On the periphery of the outside disk are cut 100 wormwheel teeth, while on the periphery of the inside disk are cut 99 teeth. The two disks are mounted on a single stud and for every hundred revolutions of the worm the rear disk advances one hundredth of a division over the front disk. The front disk is graduated in hundredths, and the rear disk in ninety-nine divisions, each representing 100 revs. The central stud is mounted on a pivot arm so that the split wormwheel can be disengaged from the worm for resetting.

The signal device is also mounted upon this central stud and carries two levers, one for setting the predetermined number of revolutions, the other for engaging a trip. The mechanism is so designed that when more than 100 revolutions are being counted the trip lever does not engage the trip at the end of the first nor any subsequent revolution of the outside disk before the number actually set is approached.

The disks are about 4 in. in diam. and are made of bronze, nickel plated. The driving worm is made of steel.

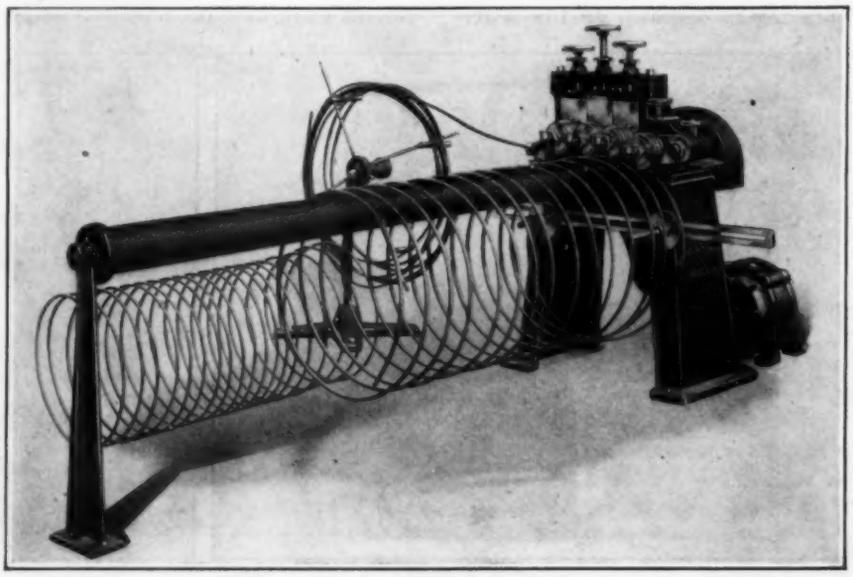
Kane & Roach Coil-Bending Roll

The coil-bending roll shown in the accompanying illustration has been developed by Kane & Roach, Syracuse, N. Y. The machine has a capacity for coiling machine steel wire ranging from $\frac{1}{4}$ to $\frac{5}{8}$ in. in diameter.

The particular application pictured shows the roll with passes for bending $\frac{3}{8}$-, $\frac{1}{2}$-, and $\frac{5}{8}$-in. round stock into a circle of any desired diameter with the same set of rolls. The machine can be arranged for direct connection to a motor or for belt drive. It is made in several sizes. These coils are for use in reinforcements in cement conduits, sewer pipes, and other concrete work.

The wire first passes through six straightening rolls to take out the kinks and bends. The upper straightening rolls are adjustable and are equipped with pointer scales so that a record of the settings for various diameter of wires can be kept. These scales facilitate re-adjustments when changing from one diameter stock to another. The bending roll, which is an idler, is also equipped with a pointer scale for a record of the setting of circles of various diameters. Besides being adjusted for any required diameter of circle for bending, this roll is also adjustable in and out to regulate the width of spacing between the coils.

In addition to the straightening and bending rolls, the machine is equipped with two lower side rolls that control the coil and keep the same in a uniform diameter. These rolls are also adjustable for diameter and for different widths and spacings between the coils. Where large diameter coils are required, the machine is equipped with a third lower roll located directly underneath the straightening rolls.



Kane & Roach Coil-Bending Roll

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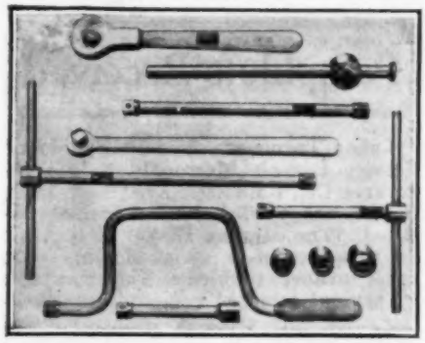
The rolls are made of high-carbon steel, heat-treated. Passes are cut in the rolls to fit the material being bent. Both the upper and lower rolls are gear driven by means of cut steel gears.

The arbor that supports the coil revolves and is connected to the lower bending roll. It is supported by an outer bearing that can be moved by hand or can be mounted on a slide rail so that it can be quickly dropped to permit the arbor to be pulled out and the completed coil taken off. With this construction the strain or back spring that would result if the coil were compelled to rotate around a stationary arbor is eliminated.

Bonney Chrome-Vanadium Detachable-Head Socket Wrenches

A complete line of detachable-head socket wrenches made of chrome-vanadium steel are being marketed by the Bonney Forge & Tool Works, Allentown, Pa. The



Bonney Chrome-Vanadium Detachable-Head Socket Wrenches

sockets are forged from solid bar stock instead of being stamped from tubing, and the heads have been designed with sufficient strength so that the bolt will break or the thread will strip before the wrench is damaged. The use of chrome-vanadium steel furnishes sufficient strength with a thin wall, which is necessary for close corner work.

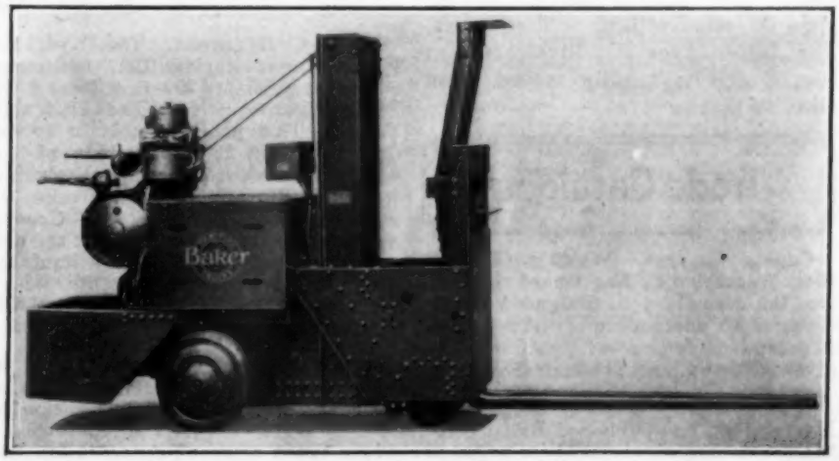
In addition to this complete line of sockets, this company has developed an assortment of handles for use with them, also forged of chrome-vanadium steel. Solid offset handles, ratchet offset handles with reversible lugs, "T" handles of various lengths, sliding "T" handles, ball bearing brace-type handles of various lengths are offered. Extension bars can be used with any of the handles for reaching otherwise inaccessible places.

The socket heads have a ¾-in. square lug, which is practically standard for all detachable-head socket wrenches so that these heads are interchangeable with other heads and handles. Adapters are also provided so that the handles may be used for very large sized sockets, many of which have a ⅞-in. square lug.

Baker "Hy-Lift" Truck for Carrying Crates

The Baker-Raulang Co., Cleveland, Ohio, has adopted its "Hy-Lift" truck for carrying large crates, or similar packages, as shown in the accompanying illustration. The carriage is fitted with two forks placed on the usual platform and clamps are provided for securely holding either one or two packages. This machine was developed for a particular job in which cabinets were packed in crates of uniform size, to which 3 x 3-in. cleats were nailed to the bottom. These cleats raised the crate above the floor sufficiently so that it could be picked up with the forks.

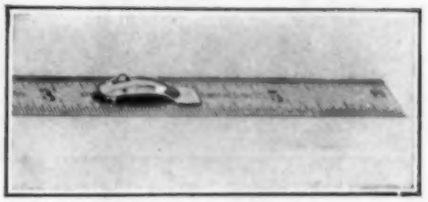
The clamping action is entirely automatic and takes effect as soon as the truck commences to lift. One crate may be picked up and placed on top of another and then both of them carried on one load. In this case the lower clamp drops back out of the way and the upper clamp comes into operation.



Baker-Raulang "Hy-Lift" Truck for carrying crates

Starrett Rule "Klip"

The L. S. Starrett Co., Athol, Mass., has devised a so-called "klip" for use with their 6-in. flexible steel rule for pocket use. With this device, the rule is firmly held in the



Starrett Rule "Klip"

vest pocket or other part of the clothing. The harder the rule is pulled the more firmly it holds. It is released by applying downward pressure upon the pawl. The klip is permanently soldered at the 4-in. mark, which is considered the average pocket depth. The device should minimize the frequent loss of small flexible steel rules.

Thompson Portable Rubbing Machine

The Thompson Rubbing Machine, Inc., Binghamton, N. Y., has placed on the market the rubbing machine shown in the accompanying illustration, Fig. 1. The machine is intended for sanding, polishing, and rubbing any surface by means of reciprocating motion, and its flexibility is claimed to make it suitable for work on concave, convex or flat surfaces. The reciprocating pads are easily detachable. The machine is used for both wet and dry rubbing.

The machine is light in weight

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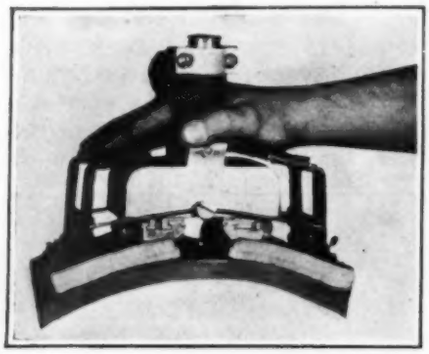

Fig. 1—Thompson Portable Rubbing Machine

and when counterbalanced with its driving equipment, only the weight of the rubbing head is carried by the operator. An electric motor furnishes the power through a flexible

Fig. 2—Floor-Type Rubbing Machine

shaft. The rubbing machine is supplied in either ceiling or floor types. The latter type is illustrated in Fig. 2 and is readily moved from place to place.

Trade Catalogs

Cupola Charger. Whiting Corporation, Harvey, Ill., has issued Bulletin No. 182 describing its Balanced Cupola Charger. A description of the construction and operation of the device is given. The bulletin is illustrated.

Dust Filter. Whiting Corporation, Harvey, Ill., has published Bulletin No. 181 containing eight 8½x11-in. pages on its Dust Filter. The design and construction of the unit is described in considerable detail and the text is supplemented by many photographs and line cuts.

Heat-Treating Methods. The Stanley P. Rockwell Co., 66 Trumbull St., Hartford, Conn., has issued bulletin No. 2611 in which a comparison is made of several methods of precision heat-treatment. The magnetic, the time-temperature, and the time-dilation method are each discussed in turn. The last involves the use of the Rockwell Dilatometer.

"Nitralloy." The Ludlum Steel Co., Watervliet, N. Y., has published an 8-page pamphlet on "Nitralloy," a special steel capable of being case hardened at low temperature with little deformation. A technical description of the process, which is one of nitruation instead of carbonization, is given. The physical properties after heat-treating of the three grades, A, B and C, are presented, and examples of parts used in various automobile and airplane racing abroad are given. The pamphlet is illustrated.

Pneumatic Collecting and Conveying Systems. B. F. Sturtevant Co., Hyde Park, Boston, Mass., has published Catalog No. 291 on the above equipment. It contains seventy-two 8½x11-in. pages and is profusely illustrated, largely by halftones. Part 1 of this bulletin is devoted to the description of apparatus. The advantages of pneumatic systems for conveying fibrous materials and for dust collectors for use in conjunction with such apparatus as sand-blast machines, tumbling barrels, grinding wheels, and wood working machinery, and so forth, are presented. Part 2 includes data covering design and application of collecting systems. The engineering method and design used in dust conveying systems are given. Tables of area and weight of round galvanized pipe, area of circles, friction loss in pipes, performance tables and other miscellaneous tables are given. The methods of determining the size of fans and pipes, size of connections for grinding wheels and wood working machinery are also presented.

Presses, Hydraulic. The Hydraulic Press Manufacturing Co., Columbus, Ohio, has published the first issue of its house organ entitled "The Hydraulic Press." This publication is to appear quarterly. In it applications of hydraulic presses to the metal-working, woodworking and chemical process industries, will be described. General subjects relating to press work are also covered; for instance, in this issue appears an article on Bakelite. New equipment is also described. Howard F. MacMillin is the editor of the paper.

Speed Reducers, Lubrication of. Foote Bros. Gear & Machine Co., Chicago, Ill., has published lubrication instructions for its IXL speed reducers. Three types of speed reducers are considered: spur gear, herringbone, and worm gear. The construction of each type is first explained, then its installation, followed by a description of the oiling system, and recommendations for the proper grade of oil. The bulletin is illustrated by means of many photographs.

Tumbling Mill. Whiting Corporation, Harvey, Ill., has issued Bulletin No. 180 on its Tumbling Mill. In this publication fifteen points of superiority are enumerated. The bulletin is illustrated.

Tools. The McCrosky Tool Corp., Meadville, Pa., has published catalog No. 10 on its so-called cost-cutting tools. This publication contains sixty-four 6x9-in. pages and is profusely illustrated with halftones and a few line cuts. About half the space is devoted to adjustable reamers. The remainder of the booklet is devoted to quick-change chucks and collets, and equipment for engine lathes such as turrets, steadyrests, and faceplates.

Twist Drills. New Process Twist Drill Co., Taunton, Mass., has published its catalog No. 28. This booklet contains twelve 6x9-in. pages bound in loose-leaf form. Complete specifications for the various hot-forged twist drills made by this company are given. Short-body car drills, bonding drills, high-speed flat track bits, and various other special drills are listed. The catalog is illustrated.

Pamphlets Received

Labor Turnover. The Policyholders' Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York, N. Y. has published a pamphlet entitled, "The Moving Finger Writes—," as the first of a series dealing with labor turnover problems. The experience of several hundred companies in dealing with this problem is incorporated in the report. It is pointed out that good will in industry depends upon good supervision, which in turn implies satisfactory labor policies. Since the first essential of proper supervision is some method of determining the true facts, a suitable record form for analyzing labor turnover should be kept.

Nickel and Nickel-Chromium Steels, Physical Properties Of. The International Nickel Co., 67 Wall Street, New York, N. Y., has published Bulletin No. 9 under the above title on nickel steel. The information was compiled by Development and Research Department of this company. The bulletin contains sixteen 8½x11-in. pages, perforated for binding. For fourteen S.A.E. standard nickel and nickel-chromium steels, curves showing the average values of tensile strength, elastic limit, reduction of area, elongation, and Brinell hardness at various drawing temperatures are given. In addition tables of the maximum and minimum values of these same properties are also given.

News of the Week

International Activity in Aviation

The International Commission of Air Navigation held its eleventh session in Paris last month with 22 nations represented. The United States, which had unofficial observers at previous meetings of the commission, was not represented this year. Among important decisions taken at the Commission were the following: action regulating the procedure of technical inquiries into accidents occurring to aircraft in foreign countries; simplifying the international model of the "carnet de route" (traveling permit) for aircraft; completing requirements to be met by candidates for navigators' licenses; preparing for the projected Washington radio-telegraph conference of 1927, an outline of proposals relative to the use of wireless in air navigation. The twelfth session of the commission will be held in April, 1927, at Lisbon or London.

Statistics on the accomplishments of German civil aviation during the five-month summer season April-August, 1926, show that planes of the Luft-Hansa A. G. covered 4,000,000 kilometers of air and carried 56,331 passengers, 409 metric tons of baggage and 434 metric tons of postal matter plus freight during that period.

This year for the first time German aviation is to keep up an all-winter service. Interest is being displayed in Germany concerning the degree of regularity that will be maintained on different stretches.

A government decree announced recently at Paris, established the directing personnel of French aeronautics. Offices named in the decree include a "General Director of the Central Administration for Aeronautics," and "Aerial Transport Director of Aeronautical Construction," "Director of Aerial Routes and Communications," and "Chief of Personnel and Accounting." This arrangement of the French Aeronautical Administration ends the uncertain situation which has existed since the abolition of the office of the "Under-Secretary of State for Aeronautics."

The Hispano-American Aviation Congress, which was held recently in Madrid, Spain, was attended by the Ambassadors of Portugal and all the Latin American countries and by special delegates from Argentina and Uruguay. During the congress consideration was given to a study of the bases of a customs and transportation agreement between the Spanish and Latin American countries, which would eliminate unnecessary customs formalities and facilitate the reciprocal interchange of aeronautic equipment and the supply of raw materials to be utilized in this industry.

Plans to hold a conference of European postal administrations to discuss air mail problems were launched at a recent meeting of the air transport committee of the International Chamber of Commerce at Paris. The proposed conference would be limited to postal administrations directly interested in air traffic, and its purpose would be to study necessary modifications in the international postal convention.

Patent Office Report Shows Need for Examiners

More examiners are urgently needed if the Patent Office is to adequately cope with the constantly growing demands upon it, according to Thomas E. Robertson, Commissioner of Patents, in his annual report made public last week.

After three years of steady progress, the commissioner points out, during which the cases in arrears were reduced by 35,000, because of radical reductions in its professional personnel, the Patent Office is now unable to handle the work as fast as it is received. During the two fiscal years 1925 and 1926, the Patent Office enjoyed annual appropriations amounting to about $180,000 for the employment of 100 temporary examiners. For the current year, instead of this amount, only $25,000 is available. This situation has necessitated a reduction in the examining corps.

The present force, the commmission points out, is obviously inadequate, especially in view of the increasing amount of work coming in to the Patent Office. As an indication of this, the report shows that in two years the new cases have increased by 10,000 and the amended cases by 48,000.

The need of increased quarters is once more stressed. The housing facilities of the present building, he points out, are entirely inadequate to take care of the increasing volume of business.

Attention is called in the report to the high turnover in the examining corps as a result of the present low scale of salaries. During the last fiscal year no less than 104 of the technical and professional force resigned for this reason. The salary schedule, Commissioner Robertson states, should be revised if the high caliber men required by the Patent Office are to be attracted and held.

During the last fiscal year the Patent Office handled 110,030 applications, an increase of 6,439 over the figure for 1925. With the exception of 1922, when patent applications withheld during the war were submitted in abnormally large numbers, the number of applications filed during 1925-26 was the largest ever handled in the history of the Patent Office.

Suggests Investigation of Labor Turnover

The work of the bureau of labor statistics of the Department of Labor, states Secretary of Labor James J. Davis, has been directed in the past almost wholly to the question of what the workers receive for their labor, the number of hours required for a day's work, and what it costs the worker to live. These three factors taken together show all that can be shown statistically as to what is a fair day's wage. The old motto used to be "a fair day's wage for a fair day's work." It may be said that there is very little unbiased information as to what constitutes a fair day's work. Studies of output per man-hour in the key industries, at least, should be made, and in connection therewith an index of the cost of living would provide both sides with the essential facts in coming to an agreement on wage scales.

Another very useful survey which might well be undertaken by the bureau would be the study of labor turnover, with a special view to determining its causes and remedies. The department undertook a study of labor turnover several years ago. It was dropped in 1920, when the appropriation for the bureau was cut. Records already in possession of the bureau show that labor turnover is responsible for high accident rates, for low efficiency rates, and contributes to unemployment.

Jones & Laughlin Win Sesqui-Centennial Awards

Prizes for products exhibited by them at the Sesqui-Centennial International Exposition in Philadelphia have been awarded the Jones & Laughlin Steel Corporation of Pittsburgh.

A gold medal was awarded for the statue entitled "Steel," which was presented to the Sesqui by the Corporation as a memorial to the accomplishments of the entire steel industry of America during one hundred and fifty years of American independence. The statue, designed by Frank Vittor, is 70 ft. high and symbolizes the steel industry by three heroic figures of steel workers.

A gold medal was also awarded to Jones & Laughlin for their new "Jalcase" steel, which was brought out during the year.

A grand prize was awarded Jones & Laughlin for their cold rolled and cold-finished steel bars. Fifty years ago, in the Philadelphia Centennial exposition of 1876, a medal was awarded to this firm for the same product.

A medal of honor was awarded to the "Junior" beam, a light-weight, structural, rolled-steel building section, brought out this year.

Exports of American Machine Tools Reach Post-War Peak

One-sixth of American machine tools sold abroad

About 17 per cent, or over one-sixth of the machine tools built in the United States during the year 1925, were marketed abroad. An estimate of the total production of machine tools in this country shows that it approaches $124,500,000. As shown in Table I, which is based on a report of the Department of Commerce, the value of the machine tools sold abroad is $21,347,840. This report reveals the activity of the United States as an exporter of machinery. The importance of our export trade is apparent when the volume of business done with foreign countries is compared with that done in this country.

The principal markets for American machine tools are listed in Table I in the order of their consumption during 1925. Twenty-two countries are shown in the list and an examination of the figures included in the table shows that these twenty-two countries absorb nearly the entire amount of machine tools exported. A large percentage of the total is represented by the six leading consumers of American machine tools. Each of these six buys well over a million dollars' worth of American products, while the figure for Great Britain is nearly four million dollars.

The number and value of each class of machine tools exported are shown in Table II. Lathes, with a value of over two and a half million dollars, head the list of exports. Grinding machines are a close second, while thread-cutting and milling machines follow. A great number of small tools and accessories are also marketed abroad.

Table III shows that Italy was the largest market for American lathes and that Germany was our principal market for grinding machines. The largest exports of small tools and accessories were to Great Britain. It is interesting to note, as shown in Table I, that Great Britain, Germany and France are all larger markets for American machine tools than is Canada.

These three tables indicate that the export trade is an important factor in the marketing of American machine tools. The deflation of some foreign currencies and the unsettled business conditions in Europe have made the exporting of this equipment more difficult but the figures quoted are encouraging especially since the trend of the export curve is now upward.

The export trade in machine tools of four leading nations is shown by the following figures obtained from the French-American Chamber of Commerce and from the Consular offices of Germany, Japan and Great Britain, in New York. The exports of France during 1925 amounted to 12,288 short tons and were valued at 80,352,000 francs. The latter value, at the average exchange rate of the franc for 1925, is equivalent to $2,812,320. This figure can be taken only as indicative since the financial depression in France has considerably affected the buying power of the franc. During the year 1924, Germany exported 49,545 tons of machine tools valued at 68,310,000 marks or $16,264,285. The exports of Great Britain, during the year 1925 amounted to 14,289 tons valued at about $7,915,000.

The export trade of Germany is especially noteworthy in view of the fact that her foreign trade was practically destroyed during the war and has been built up since that time. The competition between nations in the export of machine tools is making the contract between the machine tool builder and the foreign buyer an increasingly important factor in the development of foreign markets.

Table I—Principal markets of machine tools, 1925

Principal Market	Value of American Exports
Great Britain	$3,910,003
Germany	2,965,980
France	2,382,776
Canada	2,162,993
Italy	1,709,150
Japan	1,187,545
Russia in Europe	881,959
Australia	804,036
Mexico	533,318
Chile	470,131
Netherlands	364,656
Argentina	318,662
British India	315,109
Spain	314,943
Cuba	299,178
Sweden	299,027
Brazil	275,681
British South Africa	258,483
Czechoslovakia	256,423
Colombia	238,675
Belgium	180,718
Venezuela	125,432
Total	$20,254,878
Other Countries	1,092,962
Grand Total	$21,347,840

Table II—Machine tools exported by classes, 1925

Machines	Number Exported	Value of American Exports
Lathes	1,542	$2,584,465
Boring and drilling machines	1,737	629,301
Planers, shapers and slotters	305	563,633
Bending and power presses	428	594,916
Gear cutting machines	400	816,361
Milling machines	1,008	1,630,611
Thread cutting and screw machines	919	1,192,596
Punching and shearing machines	205	194,510
Power hammers	236	246,092
External grinders	1,328	1,813,620
Internal grinders	327	644,576
Other grinding and sharpening machines		616,944
Chucks		333,105
Small tools		2,747,560
Pneumatic portable tools		1,157,667
Other machines and parts		5,581,883
Total value		$21,347,840

Table III—Principal markets of machine tools by classes, 1925

Machines	Principal Market	Value of American Exports
Lathes	Italy	$ 631,947
Boring and drilling machines	Japan	91,375
Planers, shapers and slotters	Germany	153,922
Bending and power presses	Canada	135,927
Gear cutting machines	Germany	393,802
Milling machines	Great Britain	316,614
Thread cutting and screw machines	Great Britain	276,255
Punching and shearing machines	Chile	37,851
Power hammers	France	55,391
External grinders	Germany	682,265
Internal grinders	Germany	247,144
Other grinding and sharpening machines	Canada	108,177
Chucks	Great Britain	94,721
Small tools	Great Britain	576,191
Pneumatic portable tools	Great Britain	289,815
Other machines and parts	Great Britain	1,285,095

Machinery Exports Show Decrease in October

United States exports of industrial machinery during October, 1926, totaled $11,682,604, and represented a decrease as compared with $12,588,039 for the corresponding month of 1925, and $14,391,358 for September, 1926, states the industrial machinery division of the Department of Commerce. Notwithstanding this decline from the preceding month, however, the average monthly exports for the ten months of the current year remain considerably in advance of that for the same period of 1925, amounting to $12,857,455 as compared with the average of $12,246,939 for the corresponding ten months of 1925.

Shipments during October show declines as compared with the corresponding month of 1925 in all of the principal industrial machinery groups, with the exception of mining, oil-well, and pumping machinery. The latter group has manifested very marked activity during the present year.

The largest decline for the month of October occurred in the power-generating machinery group—approximately 25 per cent. Exports of metal-working machinery for the same periods were: October, 1926, power-driven $1,071,343, other metal-working machinery $490,025; October, 1925, power-driven $1,239,875, other metal-working machinery $382,519.

Exports of Iron and Steel Fell off in October

The foreign trade of the United States in iron and steel products during October was below that recorded for September, both in volume of exports and of imports, according to the iron and steel division of the Department of Commerce. Exports totaled 172,070 gross tons in October, a decrease of 10,001 tons from the September total of 182,071, while imports amounted to 81,830 gross tons, a decline of 3,654 tons from the total of 85,484 tons in the month before.

Exports of iron and steel products from the United States during the first ten months of 1926 totaled 1,749,029 gross tons, an increase of nearly 300,000 tons over the total of 1,449,229 tons shipped abroad during the corresponding period of 1925. Imports during the January-October period of this year totaled 954,272 gross tons, as compared with 777,630 tons in the same period of last year.

Papers Being Prepared for S.A.E. Meeting

Authors are already at work on the preparation of their addresses for the annual meeting of the Society of Automotive Engineers, to be held in Detroit Jan. 25 to 28. Topics that have been given a place on the program so far include light cars, chassis and engine developments, transmissions, brakes, body production and other production topics, automotive fuels, and training for the automotive industry.

These will be covered by authoritative speakers. Other topics are being offered from time to time and the society expects that the program will be completed early.

A carnival will be held by the members and their guests the night of Jan. 28 at Oriole Terrace, and a committee of Detroit members is now completing arrangements to make this a social event of unprecedented attractiveness.

Government Adopts Standard Contract

The President has just approved a standard form of construction contract for the Federal Government, with its supporting forms, consisting of an invitation for bids, a form of bid, instructions to bidders, a bid bond and performance bond. He has directed that on and after Jan. 1 these forms be used for every formal contract for the construction and repair of Federal buildings or works. They may be used prior to that date but must be used after that date.

The new form of contract is fair and equitable to both the Government and the contractor. The contractor will not be charged with liquidated damages for delay due to unforseenable causes beyond his control and without his fault or negligence. Heretofore, under the old and varying contract requirements, contractors have been penalized in cases where work has been delayed through no fault of their own and where no possible loss had been occasioned to the Government. Provision is made for partial payments as the work progresses, to save the contractors the expense of carrying charges. By simplifying and standardizing the language of the contract, making clear the exact obligations of the contractor, disputes and litigation will be avoided. Federal construction contracts will now contain the same general conditions and stipulations, irrespective of the branch of the Government making the contract, or the location of the project.

Industrial Construction in Philadelphia

An indication of the growth of industry in Philadelphia is given in the report of the Bureau of Building Inspection, which shows that during the last ten years more than $60,000,000 has been invested in the construction of manufacturing structures and workshops.

Of this total, $57,334,430 was spent in the construction of 775 manufacturing buildings, while $4,241,050 was for the erection of 885 workshops, the latter being represented by the small type of industrial construction. So far this year permits have been issued for seventy-five manufacturing buildings, costing $7,434,150, and forty-seven workshops, costing $374,825. These latter amounts are included in the ten-year calculation.

This year's record already has exceeded the previous industrial building record, which was in 1923, when eighty industrial structures were erected.

Warns Against Using Up Power Resources

In our present system of civilization every American man, woman and child has more than five mechanical horsepower working for him, the equivalent of sixty servants administering daily to their every necessity for sustenance, housing, clothing and pleasure, declared W. L. Dempsey, of the Society of Automotive Engineers' at a joint meeting of that body with the American Society of Mechanical Engineers at the Engineers' Club, St. Louis, on Nov. 19.

His plea was for a "sane and sensible outlook upon our hetic, power-drunken age, which has already arrived at such a motorized state that the consumption is far greater than the production of motor fuel, and the promise of the future is one of dire catastrophe when the natural resources are exhausted."

He scouted the notion that the inventor can overcome all obstacles by noting that none has ever been able to produce a single unit of power. He also pointed with derision at the ideas that water power and grain alcohols can supply the lack of coal oil and natural gas deposits, stating that all the combined horsepower which can possibly be produced from the huge grain crops, will only last four or five days, and that the total water power of the United States will produce only 35,000,000 horsepower, and that the 10,000,000 horsepower already developed is only two-thirds of the horsepower of licensed vehicles in the State of Missouri.

Oakite Sales Staff in Conference

The field service staff and the technical and executive departments of Oakite Products, Inc., of New York, opened their annual sales conference at the home offices of the company in New York City on Dec. 6. This month marks the company's eighteenth business anniversary and the convention for that reason took on added significance. Eighteen papers were presented by salesmen, engineers and executives, covering a wide range of subjects of particular interest to those present. The four days of the conference were occupied with group sessions and conferences at which sales and production problems were freely discussed. The annual banquet of the company closed the event.

Southern Metal Trades

Members of the Carolina division of the Southern Metal Trades Association held a meeting at Charlotte, N. C., the latter part of November, and discussed plans for association activities in that district the coming year. Another meeting of the Carolina division is to be held in February.

The association has decided to hold a larger number of divisional meetings during 1927 than heretofore, according to W. E. Dunn, Jr., of Atlanta, secretary and manager, and arrangements are now being made for many.

The Business Barometer

This week's outlook in Commerce, Finance, Agriculture and Industry based on current Developments

By Theodore H. Price
Editor, *Commerce and Finance, New York*

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AS THE end of the year approaches the student of business affairs finds himself impelled to base his conclusions upon general rather than particular conditions. The economic synthesis that has followed the war is daily becoming more apparent despite the disparagement of some, and so it happens that a proper understanding of the American situation implies a knowledge of what is going on in Europe, Asia, Mexico and South America.

For this reason the *reapprochement* of France and Germany, the success of the Cantonese General Chiang in making himself the dictator of China and the diplomatic imbroglio in which the United States and Mexico are involved must be considered in arriving at any worthwhile appraisement of our domestic situation.

This is not to say that the reawakening of China's national consciousness and the farm problem in the United States have a common cause or origin. They have not, but the leader of the Chinese revolution is described as "an autocrat carrying the banner of Communism," and many of the farm relief measures proposed in this country are distinctly socialistic, or at least paternal, in their character.

The same trend toward socialism is noticeable in England, whose coal strike would have been settled long ago if it had not been for the three or four million dollars with which the Russian Soviets supplied the British miners.

In Mexico the hand of socialism is also to be discerned behind the anti-clerical movement and the opposition to private ownership of land, and Mussolini claims to be a socialist although his present policy appears to be strongly individualistic.

These observations may seem to be irrelevant to those who want to know what the stock market is going to do or whether American business will be good or bad in the near future. They are nevertheless pertinent, for the men who make public opinion and control the reservoirs of credit are compelled to be close students of political tendencies, and if they would tell why they are becoming more cautious they would probably say that they fear for business when everyone relies upon Government rather than upon hard work and personal effort to correct its maladjustments.

The idea that the world will grow rich faster by reducing production is another economic fallacy whose wide acceptance is commencing to give some concern. In an emergency caused by great overproduction a temporary curtailment may be justifiable, but as a general proposition it is dangerous to restrict production, and that is what is now being attempted in the case of many commodities.

What's Doing in Industry

The month of December will probably show a greater volume of business in machinery and machine tools than was generally expected. In more than one important industrial center, activity has increased and indications are that some unexpected business will close before the end of the month. Taking the whole industry into consideration it must be said that business is very spotty, some localities reporting a decided absence of buying activity.

In that particular class is Detroit, where automobile production has been curtailed and buying of equipment has followed the trend. On the other hand, Chicago reports a demand above the average for this time of the year and the outlook is very promising. Slight improvement is noticed in Cincinnati, and some export business is in sight.

Milwaukee experienced an increase in buying activity in the past week, some railroad business being placed. In Cleveland conditions are dull, only single orders relieving an otherwise spotty market.

Business is better than was expected in New York, and in the New England district a spirit of optimism prevails over present conditions and the outlook for the balance of the month. Buffalo is quiet, with little expected until after the new year. Material handling and yard equipment manufacturers in Philadelphia report a fair volume of new business and the month shows signs of bringing some good orders for this class of machinery.

On the surface there is nothing that should check general business activity or interfere with our prosperity. But the outlook is somewhat perplexing and, while it presents no insuperable difficulties, it suggests circumspection.

Last week the Japanese silk producers decided to curtail their output. The week before the tea growers of British India agreed to let the unpicked tea stay in the fields. The exportation of rubber has been arbitrarily controlled for some time.

In Egypt the government decides what the cotton acreage shall be, and it has been seriously proposed that our Congress should do likewise.

In Brazil the exports of coffee are rationed out week by week. In Cuba the size of the sugar crop is predetermined by presidential edict, and nearly all the farm relief measures that are proposed in this country contemplate a limitation of the supply in some way.

The man who made two blades of grass grow where one grew before is no longer acclaimed, and the present day philosophy assumes that high prices are more desirable than plenteous harvests.

All this is, of course, fundamentally wrong, and it is because those who are farsighted realize the dangers into which it may lead that they are becoming cautious.

The foregoing may seem to be somewhat recondite, but it is the only explanation that can be offered for the hesitancy that was noticeable in most markets last week.

On the surface there is nothing to check business activity or interfere with our prosperity. But the stock market has been listless with a tendency toward lower prices. Cotton has declined. So has rubber, but it rallied somewhat on the announcement that the rubber consuming companies of the United States had formed a buying combination for self protection. Sugar has receded slightly in the face of statistics that are distinctly bullish. The grain markets are a little higher, but there is nothing that indicates a revival of speculation.

Distributive trade is fair, but the turnover appears to be slightly less than last year. November business failures are said to have been more numerous than since 1921.

The Federal Reserve statement indicates an abundance of credit, but call money has loaned as high as 5½ per cent and some bankers are again inveighing against sales on the installment plan. Automobile production is still running under last year. Car loadings continue high, but the abnormal coal traffic is chiefly responsible for the gain and it is subsiding as the British mines reopen.

Taken all in all the outlook is somewhat perplexing, but to those who remember the war time Christmas of 1916 or the commencement of deflation in December, 1920, it presents no insuperable difficulties, although it suggests circumspection.

The Industrial Review

Progress of the machinery and machine tool business in various parts of the country

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

New England

Machinery builders in the New England section are in a pleasant frame of mind. Business of the current year was good and the outlook is favorable for 1927. Earnings are better than in any of the previous four years and financial positions have improved. A New Britain corporation has distributed 7 per cent additional earnings and a Manchester corporation has distributed an extra 15 per cent this year. Production has shown substantial improvement everywhere. Generally speaking, wages have been maintained.

Heavy hardware manufacturers are encountering severe competition, to meet which a large producer has made a wage cut of 10 per cent.

Machinery business recently placed in this section included a large volume for the agricultural implement industry and the inquiry mail is indicative of a further substantial amount of business. Railroad and automotive buying is less active. Inquiries in the electrical lines are noticeably large.

Cincinnati

Taking everything into consideration, Cincinnati machine tool manufacturers state that November was a satisfactory month. In some cases there was a very slight falling off in business, comparing it to the previous month, but this is regarded as merely being due to a temporary lull, and the optimistic prediction is that the decrease will be more than made up for in December.

Selling agents report that the market is improving, and they, too, look for an increase in December. Inquiries are reported to be coming in freely, being well diversified and widely scattered.

It is stated that while several fair-sized orders were booked in the past week, the bulk of the business consisted of orders for single tools and replacements.

A few export orders, coming from Europe and South America, are reported. Orders for large planers and lathes are expected to come from the steel industry in a few days. Railroads are said to have done considerable buying against lists they recently sent out, and more business from this source is expected before the first of the year.

Machine tool plants are busy and manufacturing conditions are favorable in every way.

Buffalo

With one or two rare exceptions no increase in business was reported in the Buffalo district as the month of November closed. No improvement is expected until after January first. November closed about the same as October, one of the low months of the year. Some machine tool dealers reported it to be somewhat better than October, but these were rare and these reports were probably due to business arranged for in earlier months of the year.

There are some inquiries out for cranes for industrial purposes, but the interest in machine tools at the moment is slight.

The demand for contractors' equipment is fairly active for this season of the year and there is every indication that there is to be a good business in snow removal equipment, some orders having already been placed.

General business conditions, however, are excellent. Business in the automotive field is reported brisk, with the exception of retailing which is entering its usual pre-show slump. Optimism prevails.

Cleveland

No material change has been evident in the local machine tool market in the past two weeks. Business continues to be dull and spotty with only a few orders for single pieces and replacements being closed. This hand to mouth buying indicates that purchases are being made for the immediate needs only. Inquiries are more plentiful and numerous quotations are out, but prospective purchasers are slow in closing up. The sales curve for November shows a decline in comparison with October.

Not much activity is expected during December, the machinery industry in general at the present time is experiencing its annual drop which precedes the inventory period.

Production is at normal capacity and a more confident feeling predominates due to the substantial gains made during August, September and October. A general resumption of buying is expected immediately after the first of the year.

Milwaukee

The trend of business in metal working equipment during the early days of December is toward more activity than was manifested during November. Automobile factories are making inquiry more freely and some are already acting upon responses to requests for prices and delivery dates put out last month, in order to get tools installed by the time production schedules again swing upward. General industrial plants in the metal working field, however, are furnishing the bulk of current business.

Completion of the reorganization of the Chicago, Milwaukee & St. Paul Ry. as the Chicago, Milwaukee & Pacific within the next week or two will advance action on relatively heavy requirements of equipment for its shops, of which that in Milwaukee is one of the largest. Considerable retooling has been going on at this and other points, but the major share of replacements and additions has awaited the passing of the receivership and improvement of the financial structure.

There is a dearth of new industrial construction in Milwaukee and vicinity that requires equipment in lots, but local orders are of good proportions, even if replacement needs dominate the demand.

Philadelphia

Business in the machinery, machine tool and allied lines held up fairly well throughout the Philadelphia area during the last two weeks. Fair orders for new equipment were received by some of the leaders in the industry, and there were some smaller purchases. Engineering firms engaged in general machinery repairs noticed a falling off during the last fortnight.

The activity of the automotive industry was noted through the purchase of two electric hoists for the Oakland automobile plant. The Fisher Body Co. has entered the Philadelphia market for the purchase of stokers for extension of its steam equipment plan.

Gear manufacturers reported a brisk market among industrial concerns, with tire and rubber companies in the market. Railroad shops and textile plants have been in the market for leather belting for replacements. Indications were that business in the industry would be brisk throughout December.

New York

Business in machinery and machine tools is holding up a little better than was expected for this time of the year. Inquiries for single machines for immediate delivery are being received in good numbers, and the tendency is to purchase as little as is possible until after the first of the year.

No large lists have as yet appeared, although it is generally known that more than one large industrialist is planning the expansion of plant facilities immediately after January first. As soon as the financial question has been settled it is expected that these new projects will get under way and orders for shop equipment will follow along.

A good volume of business is looked for from railroads. Recent purchases by roads in this district have been confined to single machines for replacement, or material handling equipment for yards and terminals. It is known that much round house equipment is needed and has been included in requisitions for 1927. Profits would seem to assure the purchase of this equipment.

Present indications are that December volume will at least equal that of November, which fact adds to the satisfaction of many dealers and agents in this market.

Chicago

The near approach of the holiday season, together with the preparations being made for annual stock taking and the balancing of yearly accounts, are having their accustomed effect upon the machinery market. Notwithstanding this tendency, however, reports from handlers of machine tools are to the effect that the demand is somewhat above the average for the time of year.

Used machine tools are finding a fairly satisfactory sale, and inquiries for future delivery are being received in greater number than for some weeks past. November business with a majority of machinery houses has been in excess of that done in October. The partial closing of the Illinois Steel Co.'s list, comprising about 40 tools, has created considerable satisfaction among those who have been awarded contracts, while others who have submitted prices are hopefully awaiting decision regarding the remainder of the list. The Pullman Car and Manufacturing Co.'s list is still pending.

Dealers generally are not anticipative of any material change in market conditions until after the first of the year. The news just received in Chicago regarding the shutting down of two of the important Ford plants is regarded with some misgivings by such concerns as depend on the activities of the automotive industry for a considerable volume of business.

Continued talk is heard with respect to increase in the prices of certain lines of machine tools, but up to the present none has been reported.

Detroit

The anticipated seasonal slump in machinery and machine tool sales in the Detroit district is an accomplished fact.

There is very little buying, and such as there is consists largely of single machines. Inquiries are holding up fairly well, but leaders in the field believe that there is little prospect for material improvement before the first of the year.

Of widespread interest to the machinery industry is the sudden and unexpected shutdown of the Highland Park and Fordson plants of the Ford Motor Co. Officials refuse to state the cause, but it is generally believed that they will be down for a period of two weeks or more. The lid has been clamped on tight at all offices of the company, and no information is seeping through. Veteran machine tool representatives believe it not unlikely that several shake-ups are due in personnel and methods. The latter will undoubtedly mean that Ford will commence buying equipment again after a lengthy lapse.

Contrasted to the automobile end of the Ford Motor Co. is the activity in the aeronautical field. Production of the all-metal three-motored planes by the Stout Metal Airplane Division of the company is being carried on in the new factory recently completed at the Ford Airport at Dearborn. All machinery is now in use.

General industrial activities are slowing up somewhat, and employment is the lowest it has been this year.

W. L. Jones, Steel Producer, Is Dead

William Larimer Jones, president of the Jones & Laughlin Steel Corporation, of Pittsburgh, who died at his home in that city on Nov. 25, was one of the great men in the steel industry of America, little known to the public but held in esteem by the industry and

William Larimer Jones

its affiliated industries as an operator, an executive and a leader. From the time he graduated at Princeton, in 1887, until his death, he was occupied with production of steel and was known for his alert and modern viewpoint on the present status and future development of the steel industry.

He came out of college into the mills in Pittsburgh as assistant to his father, the late Thomas M. Jones, general manager of the company, and upon the latter's death in 1889, succeeded him as general manager. In 1906 he was elected vice-president of the company and in 1922, upon the formation of the present Jones & Laughlin Steel Corporation, was made its president, succeeding his cousin, B. F. Jones, Jr., who became chairman of the board of directors.

Mr. Jones was a member of the American Iron and Steel Institute, the American Institute of Mining and Metallurgical Engineers and the Engineers Society of Western Pennsylvania.

A.S.M.E. Entertains German Students

A reception and luncheon was given on Dec. 4 by the American Society of Mechanical Engineers to the second group of German engineering students to arrive in this country. The twenty young engineers who arrived from Dresden on Dec. 3, are sent out by the German Students Co-operative Society, Wirtschaftshilfe der Deutschen Studentenshaft, and they are to be placed in various American industrial plants to work for periods of from one to two years.

The society has entered into an agreement with the United States Department of Labor to permit the entry into this country of 100 engineering students to remain for a period not exceeding two years. These students are selected from the graduates of German engineering colleges by joint committees from the universities and from German industry. They are being routed to American factories through the co-operation of American manufacturers with the New York office of the society.

Calvin W. Rice, secretary of the A.S.M.E., welcomed the students in the name of the American engineering societies, and after the luncheon they were taken for a tour of inspection of the engineering societies' headquarters at 29 West 39th St., and later shown points of interest about the city. The students left New York for their various assignments on Monday.

Bureau of Standards Is Twenty-five Years Old This Month

The Bureau of Standards celebrated its twenty-fifth anniversary on Dec. 4, 1926. Special care was taken that every department should not only be open to the visitors but that the work of each department should be explained in as much detail as desired.

Tests were under way in many different lines so that the methods used could be seen and studied. As examples: fuel was being tested in the Automotive Building; chromium plating of printing plates for producing paper currency, and by which their life has been greatly increased, was shown in the Chemistry Building; the small paper plant in which were developed the methods for making greatly improved paper for currency was in the Industrial Building.

Methods of measuring gages of various kinds, both by direct measurement and by interferometer methods, were carefully shown in the Northwest Building. This department is of particular interest to all manufacturers of metal products and is being used more and more as a court of last resort in matters pertaining to measurement. At present the new American Petroleum Institute standards for oil wells and similar cases is receiving considerable attention and the new standards are probably coming into use as rapidly as could be desired.

Inspection of the several divisions and the sixty specialized laboratories which they contain took up the entire day with a buffet luncheon in the Industrial Building and a celebration dinner at the New Willard Hotel. Dr. Burgess and his assistants received many congratulations on the showing made and the work that is being done at the Bureau of Standards.

Personals

C. N. ARNOLD has been appointed chief metallurgist for the Lewis Foundry and Machine Co., of Groveton, Pa.

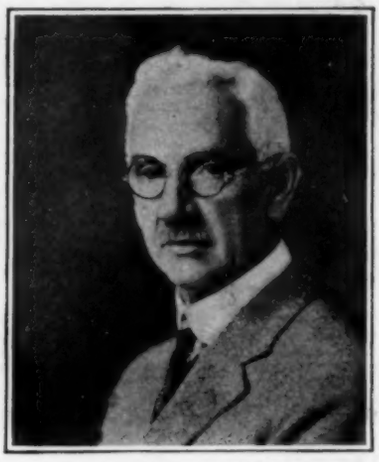
L. E. PORTER has been appointed vice-president in charge of industrial sales for S. F. Bowser & Co., manufacturers of pumps.

WALTER B. HAISLUP, general sales manager of the Diamond Chain and Manufacturing Co., of Indianapolis, has returned from a three months European trip in the interests of his company.

MELVIN A. TAYLOR has been elected a director of the General Electric Co. Mr. Taylor is a well-known banking official and is also a director of Fairbanks, Morse & Co., and the Austin Nichols Co.

A. W. SCARRATT has joined the engineering staff of the Hyatt bearings division of the General Motors Corporation. He was formerly with the Minneapolis Steel and Machinery Co.

JAMES H. WESTCOTT, for the past forty years superintendent of the Westcott Chuck Co., of Oneida, N. Y., has retired. Mr. Westcott succeeded his father, the late John H. Westcott, in the management of



James H. Westcott

the organization, which was founded in 1885. The Westcott chuck was invented and perfected by John H. Westcott and is one of several similar mechanisms patented and manufactured by this company.

E. W. MATTHEWS has been appointed manager in charge of the new Southeastern branch recently opened at 1207 Fourth National Bank Bldg., Atlanta, by the Universal Crane Co., of Cleveland.

O. M. OLSEN, field engineer for the U. S. Silica Co., will join the organization of the American Foundry Equipment Co., Mishawaka, Ind., on Jan. 1, 1927. He will serve in the capacity of consultant field engineer and direct representative of the president.

J. J. GILMORE, for some time identified with the Birmingham, Ala., offices of the American Steel and Wire Co., has been appointed director of sales for the Birmingham district, which has been enlarged and now covers the Alabama, Mississippi and Louisiana territory.

E. T. STRONG, general sales manager of the Buick Motor Co., has been elected president of the organization, to succeed the late Harry H. Bassett. C. B. Durham, assistant general manager of the company, has been made vice-president of the Buick unit.

W. C. STRUNK, who has been in charge of stoker negotiation work at the South Philadelphia Works of the Westinghouse Electric and Manufacturing Co., was recently appointed stoker specialist in the New York district, succeeding E. R. Stone.

FAYETTE W. ALLPORT, commercial attaché of the Department of Commerce in Germany, will start from San Francisco on Dec. 11 for a business tour of the United States. He will visit important industrial centers in an endeavor to promote trade between this country and Germany.

Business Items

The Millspaugh & Irish Corporation, of Indianapolis, builder of taxicap bodies and custombuilt closed car bodies, has completed plants for opening a Detroit assembly plant in the factory formerly occupied by Graham Brothers, on Conant Road.

The Farr Electric Service Co., of 228 W. South Temple St., Salt Lake City, Utah, has been appointed sales representative in that territory for the Electric Controller and Manufacturing Co., of Cleveland.

The Prest-O-Lite Co., of New York, announces that it will soon begin the construction of a new plant in Cincinnati. This building will be located on Brotherton Road and is expected to be in operation by March, 1927.

The Buhl Aviation Co., successor to the Buhl-Verville Airplane Co., is moving all its factory equipment to Marysville, Mich., a few miles northeast of Detroit, where the company has leased the former plant of the Illinois Tool Co.

The Rapid Addressing Machine Co., of 46 West 23rd St., New York, announces the removal of its plant and general offices to a new building on First Ave., Roselle, N. J. A sales office will be continued at the above address in New York.

The Wheeler-Murray Co., specialists in construction equipment and snow-removal equipment, has moved to larger quarters at 329 Ellicott St., Buffalo, N. Y. This company has also opened a branch office on South Clinton St., Syracuse, N. Y., in charge of William Birdsall.

The Atlantic Coast Line Railway Co. has awarded contracts for the construction of machine shop buildings at St. Petersburg, Fla., the plant to be completed during the early part of 1927, it is announced by J. E. Willoughby, of Wilmington, N. C., chief engineer.

The R. K. LeBlond Machine Tool Co., of Cincinnati, announces the appointment of the Eccles & Davies Machinery Co., of Los Angeles, as its representative in lower California. The C. F. Bulotti Machinery Co. of San Francisco, will represent LeBlond in northern California.

The National Plating and Enameling Co., of Jackson, Mich., has purchased five buildings and 32 acres of land formerly owned by the Earl Motors Co., also of Jackson. J. A. Watson, president of the National concern, states that the newly-acquired plant will be in operation within a short time.

The Mullite Refractories Co., Inc., of Shelton, Conn., has organized to deal in and manufacture appliances used in smelting and manufacturing refractories, furnace and kiln linings, firebrick and crucibles. The incorporators are Vincent W. Quinn, H. George Carroll and Charles F. Bailey.

The Auglaise Hoist and Body Co., and the U. S. Body Sales Co., Inc., were merged with the U. S. Hoist and Body Co., at a meeting of stockholders, held in New Bremen, Ohio, on Nov. 27. Plans are under way for the expansion of facilities to manufacture hydraulic hoists and an automobile dumping body.

The Harris-Seybold-Potter Co., a Delaware corporation, has been organized. This company will succeed the Harris Automatic Press Co., of Cleveland, Ohio, which is acquiring by purchase the business and properties of the Seybold Machine Co. and the Premier & Potter Printing Press Co. The new organization will continue the manufacture and building of machinery for printers, lithographers, and allied industries.

The Sanders Manufacturing Co., of Atlanta, announces that it has acquired the business of the A. A. DeLoach Manufacturing Co., also of Atlanta, and in conjunction with the Wrinkle Brothers Foundry and Machine Co., of Dalton, Ga., will continue operation of the DeLoach plant, manufacturing machinery for saw, shingle and grist mills. The DeLoach company is one of the pioneer machinery manufacturing firms in the South.

The sale of the plant of the Shartle Bros. Machine Co., located at Clark St. and the Big Four R.R., Middletown, Ohio, to a Chicago syndicate for a price of $1,500,000 has been announced. Charles W. Shartle, former head of the concern has moved his office to the Middletown Machine Co., which is also owned by the Shartle company. Homer D. Martindale will remain in charge of the properties of the Seybold Machine Co. and Shartle Bros. plant. No change in the policies will be made. The plant specializes in the manufacture of paper mill machinery and pumps.

Joseph T. Ryerson & Son, Inc., have purchased the warehouse division and property of the Bourne-Fuller Co., at Cleveland. The Bourne-Fuller Co. will concentrate on the manufacturing of steel products. The Ryerson company will add to the facilities and increase the size and range of stock carried. They will also add other products to complete the line. This will be the ninth Ryerson plant. The others are located at Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Buffalo, Boston and New York.

Obituaries

CHARLES C. BAKER, vice-president of the National Transit Pump and Machine Co., of Oil City, Pa., died at his home in that city on Nov. 27. He was 63 years old.

W. J. TURNER, district manager in charge of the Atlanta branch for the Ingalls Iron Co. was killed recently when his automobile was struck by a Southern Railway freight train.

FRANK S. HOYT, for many years superintendent of the Harrington & Richardson Arms Co., Worcester, Mass., manufacturer of firearms, died at his home in that city on Nov. 20. Mr. Hoyt was 68 years of age. He had been associated with that company for 50 years.

ALBERT HAMILTION EMERY, nationally noted inventor, died on Dec. 2 at his home in Glenbrook, near Stamford, Conn., after a brief illness. Mr. Emery, who was 92 last June, had been in good health until his recent illness.

Mr. Emery was best known for his designing of machinery for testing purposes. His first invention was a testing machine which has been in use for many years at the Watertown (Mass.) arsenal. It opened a wide field for experimental work.

Among other testing machines of his design are two installed at the Bureau of Standards in Washington, one of 230,000 lb. capacity for tension and compression, and the other of 150,000 lb. capacity for tension and of 2,300,000 lb. for compression on specimens of all lengths up to 33 ft. He also invented and developed the method of constructing guns by hydraulic radial expansion.

Mr. Emery retired from business seven years ago, being succeeded by his son. One of his recent inventions is a railway track scale, which has performed important service for the Pennsylvania, Illinois Central and several other railroad systems.

Calendar of Local Meetings

Society of Automotive Engineers

Washington Section. Dec. 9. Hotel Hamilton. "Cost of Motor Coach Operation in Washington," by Edward Pardoe.

Indiana Section. Dec. 9. Hotel Severin, Indianapolis. "Advantages of All-Steel Body," by E. J. Baisley. "Advantages of Fabric Body," by H. Steinbrugge.

Southern California Section. Dec. 10. City Club, Los Angeles. "Latest Developments in Aeronautics," by D. W. Douglas.

Chicago Section. Dec. 14. Western Society of Engineers headquarters. Discussion on Motor Coaches.

Pennsylvania Section. Dec. 14. At Kugler's, Philadelphia. "What Is Going On in Philadelphia,"—open discussion led by prominent members.

Metropolitan Section. Dec. 16. Hotel Woodstock, New York City. "Maintenance, Operation and Service," by Col. John Stillwell.

American Society of Mechanical Engineers

Tulsa, Okla. Dec. 9 and 10. Corrosion Conference on Oil Field Equipment, Mayo Hotel. Meeting under the direction of H. B. Bernard, chairman of Mid-Continent Section, A.S.M.E.

Knoxville, Tenn. Dec. 13. "Marble Machinery and Its Handling," by John V. Pierce.

Cleveland, Ohio. Dec. 16. Carnegie Hall. Presentation of a paper—"Blooming Mill Practice," by G. A. V. Russell, of England.

National Association of Cost Accountants

Boston Chapter. Dec. 16. "Plans for the Taking of Physical Inventories," by Stanley G. H. Fitch.

Buffalo Chapter. Dec. 16. "Inventories," by Lewis D. Crusoe.

Cleveland Chapter. Dec. 15. "The Budget as a Business Compass," and discussion of Question Box topics.

Detroit Chapter. Dec. 16. "Hidden Costs in Industry," by C. A. Hoskins.

Erie Chapter. Dec. 20. Budgetary Control and Predetermined Standard Cost.

Hartford Chapter. Dec. 21. "Visualizing Costs," by Carl F. Dietz.

Hawaii Chapter. Dec. 28. "Process of Starch Extraction from Canna Root," by W. L. Doty.

Kansas City Chapter. Dec. 20. How to Read a Balance Sheet and Operating Statement.

Los Angeles Chapter. Dec. 21. Department Store Accounting and Special Christmas Stunts.

Milwaukee Chapter. Dec. 16. "Standard Costs: Scrap and Special Materials," by W. B. Castenholz.

Philadelphia Chapter. Dec. 17. Inventory Control for Manufacturing Industries.

Pittsburgh Chapter. Dec. 15. Joint meeting with Pennsylvania Institute of C. P. A.'s Speaker: A. L. Ashley.

Providence Chapter. Dec. 13. "Inventories," by W. G. Roelker, W. C. Lane and H. E. Howell.

St. Louis Chapter. Dec. 21. "Costs in the Milling Industry," by W. C. Bechert.

Rochester Chapter. Dec. 15. "The Balance Sheet," by David C. Barry.

San Francisco Chapter. Dec. 27. Preparation for Inventory.

Springfield Chapter. Dec. 15. "Federal Income Taxes on Corporations," by R. E. Bagley.

Syracuse Chapter. Dec. 21. "The Use of Ratios in the Analysis of Financial Statements," by M. Wall.

Twin Cities Chapter. Dec. 21. "How Advertising Reduces Costs," by Mac Martin and W. W. Wright.

Utica Chapter. Dec. 13. "The Use of Balance Sheets and Operating Statements," by C. O. Wellington.

Forthcoming Meetings

National Exposition of Power and Mechanical Engineering. Fifth event, Grand Central Palace, New York City, Dec. 6 to 11. I. E. Moultrop, chairman advisory committee, Edison Electric Illuminating Co., Boston, Mass.

American Association for the Advancement of Science. Annual meeting University of Pennsylvania, Philadelphia, Pa., Dec. 27 to Jan. 1. Sam Woodley, executive assistant, Smithsonian Institution, Washington, D. C.

American Engineering Council. Annual meeting, Hotel Mayflower, Washington, D. C., Jan. 13 to 15. A. C. Oliphant, assistant secretary, 26 Jackson Place, Washington, D. C.

Society of Automotive Engineers. Annual meeting, Detroit, Jan. 25 to Jan. 28. W. Delchamps, chairman, meetings and sections department, 29 West 39th St., New York.

The Weekly Price Guide

Rise and Fall of the Market

FINISHED steel demand is slack and the same condition prevails all the way back to pig-iron. Improvement is expected to develop shortly in railway and automotive materials, sheets and cold rolled strip steel. Prices of semi-finished steel, bars and rolled material generally, are firm. Fabricated brass and copper quotations are lower this week, reflecting conditions in the non-ferrous metals market. Scrap copper, brass, lead and zinc dropped slightly, here and in the West.

(All prices as of Dec. 3)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$24.19
Northern Basic	20.89
Southern Ohio No. 2	21.39
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	26.37
BIRMINGHAM	
No. 2 Foundry	20.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	23.76
Virginia No. 2	28.19
Basic	21.26
CHICAGO	
No. 2 Foundry local	21.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	24.55
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.76
Basic	20.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	5.00@5.25
Cleveland	5.00@5.25
Cincinnati	5.00@5.50
New York	5.25@5.50
Chicago	5.25@5.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.40	3.50	3.25	3.89
No. 12	2.45	3.55	3.30	3.94
No. 14	2.50	3.60	3.35	3.99
No. 16	2.60	3.70	3.45	4.09
Black				
Nos. 18 to 20	2.90	3.75	3.60	4.15
No. 22	3.05	3.90	3.75	4.30
No. 24	3.10	3.95	3.80	4.35
No. 26	3.20	4.05	3.90	4.45
No. 28	3.35	4.20	4.05	4.60
Galvanized				
No. 10	3.25	4.10	3.95	4.40
Nos. 12 to 14	3.35	4.20	4.05	4.50
No. 16	3.45	4.30	4.15	4.60
No. 18	3.60	4.45	4.30	4.75
No. 20	3.75	4.60	4.45	4.90
No. 22	3.80	4.65	4.50	4.95
No. 24	3.95	4.80	4.65	5.10
No. 26	4.20	5.05	4.90	5.35
No. 28	4.45	5.30	5.15	5.60

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv
1 to 3 in. steel butt welded.	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded.	48%	35%	53½%	40½%	51%	38%

Malleable fittings: Classes B and C, banded, from New York stock sell at list plus 4% less 5%. Cast iron, standard sizes, 36-5% off.

Size, Inches	List Price per Foot	Diameter in Inches — External	Diameter in Inches — Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at warehouse in lots of less than 100 ft.:

Thickness — Decimal	B.W.G. and Fractions	Outside Diameter in Inches — ¼	⅜	½	¾	1	1¼	1½
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse prices in cents per pound in 100-lb. lots:

	New York	Cleveland	Chicago
Spring steel (light) (base)*	7.00	6.00@7.50	4.65†
Spring steel (heavier)	4.00	....	4.00
Coppered Bessemer rods (base)	6.05	6.00	6.20
Hoop steel	4.49	3.65	4.15
Cold rolled strip steel	6.25	6.35	6.25
Floor plates	5.25	5.30	5.00
Cold drawn shafting or screw	4.00	3.90	3.60
Cold drawn flats, squares	4.50	4.40	4.10
Structural shapes (base)	3.34	3.10	3.10
Soft steel bars (base)	3.24	3.00	3.00
Soft steel bar shapes (base)	3.24	3.00	3.00
Soft steel bands (base)	3.99	3.20	3.65
Tank plates (base)	3.34	3.20	3.10
Bar iron (3.00 at mill)	3.24	3.21	3.00
Drill rod (from list)	60%	55%	50%

Electric welding wire, New York, ⅛", 8.35c.; ¼", 7.85c.; ⅜ to ½", 7.35c. per lb. *Flat, ⅛"@½-in. thick. †F.o.b. cars.

METALS

Current Prices in Cents Per Pound

Copper, electrolytic (up to carlots), New York			14.87½
Tin, 5-ton lots, New York			73.00
Lead (up to carlots) E. St. Louis	7.80	New York	8.62½
Zinc (up to carlots) E. St. Louis	7.10	New York	8.12½

	New York	Cleveland	Chicago
Antimony (Chinese), ton spot.	15.50	18.00	15.00
Copper sheets, base	22.25	22.00	22.50
Copper wire, base	19.50	19.25	16.12½
Copper bars, base	21.87½	21.87½	22.12½
Copper tubing, base	24.25	24.25	24.50
Brass sheets, base	18.62½	18.62½	18.87½
Brass tubing, base	23.50	23.50	23.25
Brass rods, base	16.37½	16.37½	16.62½
Brass wire, base	19.12½	18.87½	19.37½

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminium ingots, 98 to 99%, 1 to 15 ton lots	27.00	27.00	27.02
Zinc sheets (casks)	13.25	13.05	12.01
Solder (½ and ½), (case lots)	43.25	44.50	38½@42½
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade			91.00
Commercial genuine, intermediate grade			64.00
Anti-friction metal, general service			32.50
No. 4 babbitt (f.o.b.)			14.00
Nickel, f.o.b. refinery, cents per lb.:			
Ingots 35.00	Electrolytic 39.00	Shot	36.00

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Hot rolled nickel sheet (base)	52.00
Cold rolled nickel sheet (base)	60.00
Hot rolled rods, Grade "A" (base)	50.00
Cold drawn rods, Grade "A" (base)	58.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot	32.00	Hot rolled rods (base)	35.00
Blocks	32.00	Cold drawn rods (base)	43.00
Cold rolled sheets (base)	50.00	Hot rolled sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible heavy copper	11.87½@12.12½	11.00	10.50@11.00
Copper, heavy, and wire	11.12½@11.62½	11.25	10.00@10.50
Copper, light, and bottoms	9.50 @10.00	9.50	8.75@ 9.25
Heavy lead	6.50 @ 7.00	6.50	6.25@ 6.75
Tea lead	4.50 @ 4.75	4.50	5.00@ 5.50
Brass, heavy, yellow	7.00 @ 7.50	7.25	6.25@ 6.75
Brass, heavy, red	9.25 @ 9.75	9.25	8.50@ 9.00
Brass, light	5.50 @ 6.00	6.00	5.75@ 6.25
No. 1 yellow rod turnings	7.75 @ 8.25	7.50	7.25@ 7.75
Zinc	4.25 @ 4.75	4.00	3.50@ 4.50

TIN PLATES—American Charcoal—Bright—Per box

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box				
100-lb.,	14x20	6.45	6.10	7.00
Terne Plates—Small lots, 8-lb. Coating—Per box				
IC,	14x20	7.75@8.00	6.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13@0.17½	$0.18	$0.15@0.20
Cotton waste, colored, per lb.	.10@ .14	.13½	.12@.17
Wiping cloths, washed white, per lb	.17½	36.00 per M	.15
Sal soda, per 100 lb. keg	2.80	2.75	2.75
Roll sulphur, per 100 lb	2.70*	3.50	....
Linseed oil, per 7½-lb. gal., 5 bbl. lots	.86¼	.98	84
Lard cutting oil, 25% lard, per gal.	.55	50	48
Machine lubricant, medium-bodied (55 gal. metal bbl.), per gal.	35	35	29
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin. ft per inch of width for single ply.			
Medium grade	40–5%	40–5%	40–5%
Heavy grade	30–10%	30–10%	30–10%
Rubber transmission, 6-in., 6 ply, $1.83 per lin. ft.			
First grade	50%	50–10%	50%
Second grade	50–10%	60–5%	50–10%

*In 150-lb. bags.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.0324	$0.0324	$0.0324
Cold drawn shafting	per lb	.04	.04	.0415
Brass rods	per lb	.1637½	.1687½	.1737½
Solder (½ and ½)	per lb.	.4325	.425	.4025
Cotton waste	per lb.	.13@17½	.13@.17½	15@22
Washers, cast iron (½ in.)	per 100 lb.	7.00	7.00	7.00
Emery disks, cloth, No. 1, 6 in. dia.	per 100	3.10	3.10	3.55
Lard cutting oil	per gal.	55	.55	55
Machine oil	per gal.	35	35	35
Belting, leather, medium	off list	40–5%	40–5%	40%
Machine bolts, up to 1x30 in.	off list	40%	40%	40%

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—In sheets 9x11 in., No. 1 grade, per ream of 480 sheets:			
Flint paper	$5.40	$5.84	$5.13
Emery paper	10.71	11.00	10.71
Emery cloth	27.84	31.12	27.84
Emery disks, 6 in. dia., No. 1 grade, per 100:			
Paper	1.32	1.45	1.32
Cloth	3.10	3.50	3.05
Fire clay, per 100 lb. bag		.75	.75
Coke, prompt furnace, per net ton		Connellsville,	4.00@4.25
Coke, prompt foundry, per net ton		Connellsville,	5.00@6.00
White lead, dry or in oil,	100 lb. kegs	New York,	15.25
Red lead, dry,	100 lb. kegs	New York,	15.25
Red lead, in oil,	100 lb. kegs	New York,	16.75

SHOP SUPPLIES

Machine bolts, ¼x1½-in., per 100, $1.70. Discount at New York warehouses on all sizes up to 1x30-in., 40%; 1½ and 1¼x3-in. up to 12-in., 15%; with cold punched hex. nuts up to 1-in. dia. (plus std. extra of 10%) 30%; with hot pressed hex. nuts up to 1x30-in. (plus std. extra of 10%) 35%

Carriage bolts, ¼x1½-in., per 100, $1.00. Discount on all sizes up to 1x30-in., 30%.

Coach and lag screws, 1½x$\frac{5}{16}$in., $2.25 per 100, less 40%.

Tap bolts, 1½x¼-in., $1.00 per 100. List plus 35% at New York warehouses.

Bolt ends, 1x12-in., 10c. per lb., less 40%

Nuts, semi-finished, ¼x¼-in., 2c. each. Discount 70% for $\frac{5}{16}$-in and smaller and 65% for ⅜-in. and larger.
Case hardened ¼x¼-in., 6c. each, less 50%

Rivets, button heads, ⅜-in., ½-in., 1-in. diam. x2$\frac{1}{16}$-in. to 4½-in $5.00* per 100 lb. at New York warehouses; cone heads, same sizes, $5.20* per 100 lb. Rivets, $\frac{1}{16}$x1-in. and longer, 19c. per lb., less 50%. Same discount for tinned. EXTRA per 100 lb. for 1½ to 2-in. long, all diameters, 25c.; ⅜-in. dia., 35c.; ½-in. dia., 75c.; 1-in. long and shorter, 75c.; longer than 5-in., 50c.; less than 200 lb. 50c.; countersunk heads, 45c.

Washers, cast iron, ½-in., $7.00* per 100 lb. at New York warehouses: ⅜-in., $6.00* per 100 lb.

*For immediate delivery from warehouse.

Machine Requirements and Industrial Construction

Machine Tools and Equipment Wanted

Kan., Wichita—Western Iron & Foundry Co.—jaw riveter, 1 in. rivets, 10 in. cylinder.

Mass., Boston—(P. O. Box 1681—back geared bench lathe, equipped.

Mass., Winthrop (Boston P. O.)—E. Coughlin, 68 Birch St.—tools and equipment for proposed garage and repair shop at Shirley and Revere Sts. Estimated cost $50,000.

Mo., Fulton—T. Ball—Power threading machines, one 4 in. and one 2 in. down.

Mo., Kansas City—Essmueller Mills Supply Co., 1220 South 8th St., St. Louis—machinery and euipment including lathes, etc. for proposed roller grinding plant here. Estimated cost $50,000.

Neb., Auburn—W. H. Redmond (sheet metal)—8 or 10 ft. brake.

N. Y., Brooklyn—Art Cage Mfg. Co., 46th St. and 2nd Ave.—Spot welding machine.

N. Y., New York—P. J. Dooling, Comr. of Purchase, Room 723, Municipal Bldg., will receive bids until Dec. 17 for woodworking machinery and forging hammer for the Dept. of Plant and Structures.

Tex., Houston — San Angelo Foundry & Machine Co., c/o A. A. Koch, Pres. and Mgr.—Davis keyseater, 1¼ in. single-head bolt cutter and 12 in. pipe threading machine for proposed plant. (Steam hammer and other equipment later.)

Wis., Green Bay—D. Clabots, 501 North Maple St.—planers and band saw for 2 story planing mill recently destroyed by fire. Estimated cost $40,000.

Wis., Oshkosh—R. McMillen Co., 633 High St. (sash and doors)—woodworking machinery for proposed 2 story addition to factory. Estimated cost $40,000.

Ont., Wingham—Federal Rubber Mfg. Co., Ltd.—high speed woodturning lathe, large barrel drum sander and tumbling barrel.

Que., Montreal — S. Kahansley, 4316 Cadieut St.—complete equipment for blacksmith shop.

Opportunities for Future Business

Ala., Birmingham—Stockham Pipe & Fittings Co., 4100 North 10th Ave., manufacturers of cast iron pipe, fittings, valves, etc., awarded contract for the construction of an addition to plant to increase the capacity. Estimated cost $50,000.

Calif., Los Angeles—R. H. Orr, Corporation Bldg., Archt., is receiving bids for the construction of a 5 story, 90 x 275 ft. garage at Sixth and Mariposa Sts. for Chapman Bros., 3469 West 6th St.

Calif., Los Angeles—Troy Motor Sales Co., 1056 South Figueroa St., plans the construction of a 5 story, 155 x 200 ft. sales and service building at Wilshire Blvd and Shatto Pl.

Calif., Oakland — Super Auto Products Co., 104 Olive Ave., San Francisco, manufacturers of piston ring seals and converting semi-finished piston rings, plans the construction of a factory and shop at 37th and Magnolia Sts., here. Estimated cost $20,000.

Calif., Sacramento—County awarded contract for the construction of a machine shop. Estimated cost $6,165. Noted Nov. 18.

Conn., Bristol—New Departure Mfg. Co., N. J. Voorhees, Company Engr., plans the construction of a machine shop on North Main St. Lockwood, Greene & Co., 24 Federal St., Boston, Mass., Engrs.

Conn., Waterbury — Wenzel & Collins Inc., 128 Watertown Ave., is receiving bids for the construction of a 1 story, 40 x 104 and 40 x 50 ft. garage and repair shop. Estimated cost $40,000. H. F. Wenzel, 6 Glen Ridge, Archt.

Ill., Chicago—D. S. Klafter, 64 West Randolph St., Archt., will receive bids until Dec. 12 for the construction of a 3 story, 113 x 125 ft. factory for the manufacture of novelty furniture for Goldner Specialty Co., 1347 North Oakley Ave. Estimated cost $125,000.

Ill., Chicago—Hartman Furniture Co., 4015 Wentworth Ave., awarded contract for the construction of a 1 story, 200 x 200 ft. garage. Estimated cost $150,000. Noted Nov. 4.

Ill., Chicago—King Pneumatic Tool Co., 1737 Armitage Ave., awarded contract for the construction of a 1 story, 90 x 108 ft. factory at 2709-2717 North Ashland Ave. Estimated cost $35,000.

Ill., Chicago—S. Savage, 417 South Campbell Ave., manufacturer of ovens, will build a sheet metal shop at 1906 North Cicero Ave.

Ill., Chicago—Standard Cap & Seal Co., Fullerton and Racine Aves., manufacturers of metal bottle caps, plans the construction of a 1 story, 62 x 149 ft. addition to plant at 1210 Fullerton Ave. Estimated cost $30,000. Weiss & Niestadt, 53 West Jackson Blvd., are architects.

Ill., Chicago—Vit-O-Net Mfg. Co., 4111 Ravenswood Ave., manufacturers of electrical appliances, awarded contract for the construction of a 2 story, 60 x 100 ft. factory at 2611-2619 North Ashland Ave.

Ill., Chicago—Western Electric Co., South 48th Ave. and West 22nd St., awarded contract for remodeling and reconstructing 16 buildings, total floor area 350,000 sq.ft. at the Hawthorne Works to Turner Construction Co., 6 North Michigan Ave. Estimated cost $2,500,000.

Ia., Cedar Rapids — Speeder Machinery Corp., M. Martin, Fairfield, awarded contract for the construction of a 1 story, 120 x 160 and 80 x 100 ft. factory at 1201 South 6th St. W. here. Noted Nov. 25.

Md., Baltimore — Robbins-Buick Inc., Greenmount Ave., had plans prepared for the construction of a 2 story, 61 x 88 ft. service station at Greenmount Ave. and 25th St. Estimated cost $40,000. W. S. Austin, Maryland Trust Bldg., Engr.

Mass., Arlington (Boston P. O.)—J. Hurwitz, 40 Court St., Boston, will build a 1 story, 140 x 155 ft. garage and repair shop on Massachusetts Ave., here. Estimated cost $150,000. Miller & Levi, 46 Cornhill, Boston, Archts.

Mass., Boston—Pierce Arrow Co., 896 Commonwealth Ave., is receiving new bids for the construction of a 3 story, 100 x 300 ft. sales and service station at Commonwealth Ave. and Alcorn St. Estimated cost $400,000. H. C. Cook, 408 Pearl St., Buffalo, N. Y., Archt. Noted Dec. 2.

Mass., Brookline (Boston P. O.)—D. Miller, 43 Brookline Ave., awarded contract for the construction of a 1 story welding shop on Brookline Ave. Estimated cost $40,000. Noted Nov. 11.

Mass., Cambridge (Boston P. O.)—I. S. Stone, 53 State St., Boston, will build a 1 and 2 story repair and service garage at 367 Cambridge St. Estimated cost $40,000. Eisenberger & Feer, 46 Cornhill, Boston, Archts.

Mass., Worcester—H. Glick, 4 Beeching St., awarded contract for the construction of a 1 story repair and service garage on Portland St. Estimated cost $40,000.

Mo., Kansas City—Gleaner Mfg. Co., Independence, manufacturers of harvester combines, is having plans prepared for the construction of a 1 and 2 story plant here. Estimated cost $500,000. Private plans.

N. Y., Brooklyn—Penn Brass & Bronze Works, 107 Dobbins St., is having plans prepared for the construction of a 2 story, 40 x 100 ft. foundry. Estimated cost $25,000. G. Erda, 826 Manhattan Ave., Archt.

N. Y., New York—Columbia Metal Box Co., c/o G. A. Bagge & Sons, 157 East 44th St., Archt., is having plans prepared for the construction of a 3 story, 131 x 190 ft. garage on Rider Ave. and 142nd St. Estimated cost $300,000.

N. Y., New York—Commission of Plants and Structures, Room 1800 Municipal Bldg., is having plans prepared for the construction of an incinerator and garage at 530-540 East 74th St. Estimated cost $875,000. Private plans.

N. Y., Syracuse—The White Co., 842 East 79th St., Cleveland, O., manufacturers of trucks, plans the construction of a 2 story, 170 x 350 ft. assembly shop and show room on West Genesee St., here. Estimated cost $300,000.

O., Canton—Luehrs Co., manufacturers of industrial machinery, plans the construction of a 1 story, 120 x 150 ft. at Genoa Crossing and Pennsylvania R.R. Estimated cost $50,000.

O., Cleveland—American Stove Co., J. G. Way, Mgr., 4301 Perkins Ave., awarded contract for the construction of a 1 story, 50 x 200 ft. factory on Hough Ave. Estimated cost $60,000. Noted Nov. 25.

O., Cleveland—The Bryant Heater & Mfg. Co., E. P. Bailey, Jr. Pres., 17825 St. Clair Ave., (gas boiler heating systems), is having plans prepared for the construction of a 1 story, 75 x 180 ft. addition to factory. Estimated cost $125,000. Fox, Duthie & Foose, Vickers Bldg., Archts.

O., Cleveland—The Ford Motor Co., Highland Park, Mich., will soon award contract for the construction of a 1 story, 105 x 225 ft. car delivery building at 10610 Euclid Ave. here. Estimated cost $150,000. A. Kahn, 1000 Marquette Bldg., Detroit, Mich., Archt.

O., New Philadelphia—Dept. of Public Works & Highways, G. F. Schlesinger, Dir., Ohio-Hartman Bldg., Columbus, will soon award contract for the construction of a 1 story, 80 x 125 ft. repair and service garage. H. B. Briggs, Ohio-Hartman Bldg., Columbus, Archt. Noted Oct. 21.

Pa., Philadelphia—J. Bodek, 216 Ledger Bldg., awarded contract for the construction of a 6 story, 60 x 122 ft. garage at 819 Walnut St. Estimated cost $200,000. Noted Aug. 26.

Pa., Philadelphia—Philadelphia Motor Service Co., 19th and Buttonwood Sts., will soon award contract for the construction of a 4 story service building on Columbia St. A. J. Sauer Co., 1505 Race St., Archt.

R. I., Providence—J. Marcus, is receiving bids for the construction of a 1 story warehouse, garage and repair shop on Otis St. Estimated cost $50,000. W. Richards, 511 West St., Archt.

Wis., Menasha—Paper Roll Plug Co., Tayco St., awarded contract for the construction of a group of 1 story buildings for plant.

Wis., New London—American Plywood Co., will build a 1 story, 40 x 140 ft. addition to factory. Estimated cost $40,000. Private plans.

Ont., Toronto — National Automotive Parts, 29 Teraulay St., plans the construction of a 2 and 3 story, 33 x 121 ft. garage and show room at Grosvenor and Bay Sts. Estimated cost $150,000. G. W. Hunt, Confederation Life Bldg., Archt.

Ont., Belleville—Bd. of Education, W. J. Diamond, Secy., will soon award contract for the construction of a 3 story collegiate institute and vocational school. Estimated cost $350,000. Thomson & Johnson, 224 Front St., Archts.